THE

PHILOSOPHY

OF

NATURAL HISTORY.

BY THE LATE

WILLIAM SMELLIE,

MEMBER OF THE ANTIQUARIAN AND ROYAL SOCIETIES OF EDINBURGH.

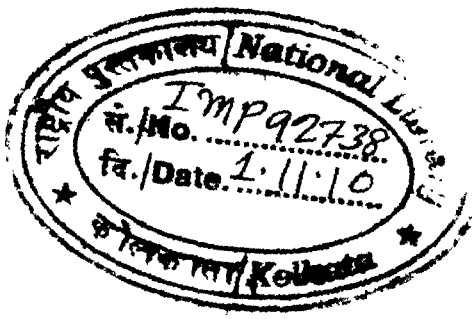
VOLUME II.

EDINBURGH:

PRINTED FOR BELL & BRADFUTE, J. DICKSON, W. CREECH, E. BALFOUR, P. HILL, A. LAWRIE, MANNERS AND MILLER, R. JACK, AND ALEX. SMELLIE, ANCHOR CLOSE, EDINBURGH; AND G. G. AND J. ROBINSON, PATERNOSTER ROW, T. CADELL, JUN. AND W. DAVIES, AND T. KAY, STRAND, LONDON.

1799.


किताबखानिज फोर्टविलियम
फोर्ट कॉलेज लाइब्रेरी


राष्ट्रीय पुस्तकालय National Library
सं./No. IMP92738
वि./Date. 1.11.10
कोलकाता Kolkata

TO HIS GRACE

THE DUKE OF MONTROSE.

MY LORD DUKE,

IN giving this Work of my late Father's to the world, I flatter myſelf that, while I diſcharge a duty to the memory of a Parent, I perform, at the ſame time, a not unacceptable ſervice to the Public. The reception with which my Father's former productions of a ſimilar kind were honoured, together with my knowledge of the attention which he paid to the perfecting the preſent work, by the acquiſition of every information which inquiry or reſearch could procure, may fairly inſpire a certain degree of confidence in the favour it may expect to obtain. One circumſtance indeed there is, which naturally creates ſome diffidence in offering this volume to the world, namely, that it is preſented under all the diſadvantages attending a poſthumous work which the death of its Author has deprived of his corrections and reviſal. From this circumſtance, however, it may, perhaps, gain as much on one hand as it loſes

on another. While it may be expoſed to the ſeverity of criticiſm, it will conciliate the indulgence of candour, and the favour of humanity. A ſenſe of thoſe amiable qualities in your GRACE emboldens me to uſher it into the world under the protection of your Name. Placed at the head of the *Society of Antiquaries of Scotland*, one of the chief purpoſes of whoſe inſtitution is the extenſion of hiſtorical and literary knowledge in this kingdom; a work calculated for the promotion of Natural Hiſtory and Science cannot be conſidered as foreign to the views of that Society, or to the notice of your GRACE as its Preſident. As Secretary of that Society, I may be allowed to embrace this opportunity of preſenting the volume to your GRACE, and of expreſſing, at the ſame time, the very high eſteem which, in common with my country, I entertain for your GRACE's character, and of that conſideration and reſpect with which I have the honour to be,

MY LORD DUKE,

With the profoundeſt reſpect and eſteem,

Your GRACE's moſt humble ſervant,

ALEX. SMELLIE.

EDIN. NOV. 15. 1798.

PRE

PREFACE.

IN a Preface to the firſt volume, I gave a ſhort view of the origin, progreſs, and general deſign of this work. With regard to the execution, it becomes me to be ſilent. But I muſt be allowed to expreſs my gratitude for the favourable reception I have obtained from public candour, or, perhaps, public indulgence. This circumſtance, though highly flattering, acts as a depreſſing power on a ſecond attempt. I feel a degree of dread, leſt I ſhould diſappoint expectation, and loſe the ſmall portion of literary reputation I may have acquired. As my plan, however, cannot be completed without another volume, I muſt ſubmit to my fate.

The

The objects exhibited by nature to our obſervation are numerous, variegated, and connected. To give even a curſory view of the whole, would exceed the powers of any human being. For this reaſon, I have hitherto confined my remarks chiefly to the animal and vegetable kingdoms. In this ſecond and laſt volume, I ſhall obſerve the ſame plan. The field is ſtill extenſive; and I ſhall endeavour to cultivate it, at leaſt, with diligence.

The ſubjects I have ſelected for the preſent publication will not, I hope, be leſs entertaining and inſtructive than thoſe of the former.

CON-

CONTENTS.

CHAPTER I.

CHAPTER II.

SECT. I.

SECT. II.

§ 1.

SECT. III.

SECT. IV.

SECT. V.

CHAPTER III.

SECT. I.

SECT. II.

CHAPTER IV.

SECT.

SECT. VI.

SECT. VII.

CHAPTER VI.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

THE

THE

PHILOSOPHY

OF

NATURAL HISTORY.

CHAPTER I.

Of Method.

SECT. I.

Of the utility of Method in every department of Science, and particularly in Natural Hiſtory—Methodical arrangement into tribes and families, both in the animal and vegetable kingdoms, is evidently founded in Nature.

METHOD is the order and diſpoſition of our thoughts, relating to a particular ſubject. It is ſo eſſential to ſcience in general, that the merit of any compoſition is principally eſtimated by the juſtneſs and preciſion with which the authors ideas are arranged.

In Compoſition, whatever be the ſubject, diſtinct ideas are not only neceſſary, but thoſe ideas muſt be diſpoſed in a certain order or method, correſponding to the general deſign of the performance. Neither is method, in this caſe, a matter of choice. It is the reſult of the particular principles and mode of reaſoning adopted by the writer. To enumerate the many advantages ariſing from methodical arrangement in ſcience, is foreign to our purpoſe. Without method, it is impoſſible to reach perſpicuity, the capital object in every compoſition.

In deſcribing a vaſt variety of objects poſſeſſing ſome univerſal and common qualities,—every individual, at the ſame time, having ſome qualities peculiar to itſelf, ſome generic or ſpecific differences which ſerve to diſtinguiſh it from the whole group, and to conſtitute a particular character,—methodical diſtribution is not only uſeful, but indiſpenſably neceſſary.

In ſuch a multifarious ſubject as natural hiſtory, which has for its object the numerous productions of animate and inanimate nature, it was neceſſary to invent ſome mode of generaliſing our ideas. The number of objects is ſo immenſe; the general figure, ſituation and ſtructure of parts in the animal tribes; their manner of living, generation, moral character, or diſpoſition of mind, the artifices employed in defending themſelves and attacking their enemies, in procuring food and providing againſt the inclemencies and viciſſitudes of the different elements, their utility to mankind, and the relations they have to each other; theſe, and many other circumſtances, are ſo various and complicated, that, without a methodical diſtribution into claſſes and genera, although perfectly arbitrary, and though no traces of any connecting principles were diſcoverable in the productions of nature, the mind

mind would inſtantly recoil, and for ever abandon the ſtudy of Natural Hiſtory, as a heap of undigeſted materials which it was impoſſible to bring into a ſcientific form, which conſequently might diſtract and confound, but could never afford any rational entertainment to an intelligent being.

But Nature, however numerous and diverſified in her productions, preſents no ſuch diſjointed and incongruous aſſemblages. On the contrary, there is not a ſingle being in the univerſe, whether animate or inanimate, endowed with a ſet of powers and qualities entirely peculiar to itſelf. If ſuch a body really exiſted, and could be recogniſed by our ſenſes, ſo powerful is the impreſſion received from the general concatenation of natural objects, that we could not heſitate a moment in pronouncing it miraculous. The variety of objects is almoſt infinite; but theſe varieties are not effected by large ſtrides, leaving ample room for farther gradations. Their limits, on the contrary, are ſo narrowly, ſo nicely defined, that conſiderable attention, joined to a habit of accurate obſervation, is neceſſary to diſcern them. The general utility of this great and benevolent plan of operation is apparent. Not to mention the other advantages of mutual dependence and relation, this variety and uniformity, thoſe beautiful connections and diſtinctions, allure us to the ſtudy of Nature, afford ſufficient materials for the conſtruction of ſcience, give riſe to all our abſtract ideas, and, of courſe, extend and enlarge our reaſoning faculties.

Every man of ordinary underſtanding, although he has given but little attention to the animals which ſurround him, has been ſo long accuſtomed, not from inſtruction, but obſervation, to arrange them into the four grand natural Claſſes of Quadrupeds, Birds, Fiſhes, and Inſects, that he is unable to recollect either the time or manner

in which he acquired the idea of this diſtribution. Without beſtowing a more particular attention, ſuch a perſon cannot be ſuppoſed to inveſtigate thoſe leſs obvious relations which ſerve as a baſis for generic and ſpecific diſtinctions.

But a ſtricter ſcrutiny into the animal creation will ſoon enable us not only to diſcern general analogies and connecting principles, but likewiſe a number of particular and ſtriking relations which characteriſe and conſtitute tribes and families.

So many common qualities occur in the great natural claſs of quadrupeds, that it is almoſt unneceſſary to mention them. They have an equal number of legs; the number of eyes and ears are the ſame; there is an evident ſimilarity in the general figure of their bodies; their ſkins are covered with hair; they are all viviparous, and ſuckle their young; their manner of generating and producing is nearly the ſame. The ſimilarities in their internal ſtructure are not leſs remarkable. They are all furniſhed with lungs to anſwer the purpoſes of reſpiration; their hearts conſiſt of two ventricles and two auricles; their blood is red and warm, &c.

Notwithſtanding the many ſimilarities that take place in the external form and internal ſtructure of the claſs of quadrupeds, the characters and features by which Nature has diſtinguiſhed the different genera or families are ſtill more numerous. Theſe diſtinctions are ſo various, and may be diſcovered in ſo many different parts of the body, in the food, diſpoſitions, and peculiar inſtincts, that they have given riſe to a great diverſity of arrangement adopted by different ſyſtematic writers.

M. de Buffon, indeed, makes the variety of methodical diſtributions an argument againſt ſyſtematic arrangement in general, as implying an uncertainty and deficiency in the natural characters. We ſhall have occaſion afterwards to take notice of the method adopted by this ingenious and eloquent author, and ſhall only, in this place, mention ſome particulars which, we imagine, will be ſufficient to convince the candid inquirer, that methodical diſtribution is not only uſeful in the ſtudy of Natural Hiſtory, but that Nature has actually preſented her productions to us, not in an immenſity of unconnected individuals, but in larger or ſmaller groups, linked together by unambiguous relations. Theſe groups are commonly known by the name of *genera* or *families*, every individual of which ought not only to poſſeſs the general properties of the claſs, but likewiſe a family character and likeneſs. The concurrence of theſe circumſtances is neceſſary to the formation of a *natural genus*, in oppoſition to *artificial* aſſemblages, to which, in ſome caſes, moſt ſyſtematic writers have been obliged to reſort, partly from the want of a ſufficient acquaintance with particular animals, and partly owing to ſome original imperfection in their principles of arrangement.

The cat-kind, the felinum genus of Mr Ray, the felis of Linnæus, comprehends the lion, tigre, panther, leopard, ounce, the cat-a-mountain, the domeſtic cat, and the lynx. The bare inſpection of theſe animals, or their pictures, without knowing any thing of their hiſtory, will at once convince us of their mutual relations, and of the propriety of placing them under one genus. But, after we have learned their hiſtory, and diſcovered the ſimilarity in their diſpoſitions, in their food, manner of ſeizing and devouring their prey, and other circumſtances in their oeconomy, we can no longer heſitate in pronouncing them a natural genus. The horſe, the aſs, and

the

the zebra; the different ſpecies of monkies; the bats; the weſels; the ſquirrels; the different ſpecies of deer; the goat-kind; the ſheep-kind; the ox-kind; the armadillos or tatus; the hare-kind: Theſe, and many others, are in the ſame circumſtances, and have an equal title to be conſidered as natural genera.

We might enumerate ſimilar examples among birds, fiſhes, and inſects; but thoſe who are unacquainted with Natural Hiſtory may believe us when we aſſert, that the ſame diſtinguiſhing features, the ſame family-connections are to be found in the animals belonging to thoſe claſſes as take place among quadrupeds; and the Naturaliſt has no occaſion to be informed of a fact with which he is already ſufficiently acquainted.

We are now fully authoriſed to lay it down as an eſtabliſhed truth, that there is a general ſubordination and concatenation in the animal kingdom, that Nature has actually diſtributed her productions into claſſes, and genera; and conſequently that thoſe ſyſtematic writers who have moſt cloſely followed the order of Nature in their methodical diſtributions are entitled to the higheſt rank in the public eſtimation.

But, although claſſes and genera be evidently founded in nature, a difficulty ſtill remains. In order to facilitate the inveſtigation of animals, naturaliſts have found it neceſſary to make intermediate diviſions between the claſſes and the genera. Theſe diviſions are called *orders*. Even in this article Nature is not altogether deficient. We are already acquainted with many inſtances, in the animal kingdom, of particular relations by which ſeveral genera of the ſame claſs are peculiarly connected. A thorough knowledge of theſe natural relations

tions is all that is neceſſary for the conſtruction of a perfect method. But there is ſuch a variety of circumſtances to be learned, of which we are as yet perfectly ignorant, that the induſtry and experience of many ages will ſtill be neceſſary, if indeed we can ever hope, for the acquiſition of this great deſideratum in natural hiſtory. A ſimilarity in the external figure or internal ſtructure is not enough. The diſpoſitions, manners, inſtincts, œconomy, &c. muſt likewiſe be thoroughly known. We are at preſent far from being ſufficiently acquainted with theſe, and many other important circumſtances, even with regard to ſeveral of our native animals. How then can we expect to ſee a perfect methodical diſtribution? What right have we to cenſure ſyſtematic writers for not arriving at an impoſſible degree of perfection in their method? It is cruel and injurious. To receive with joy the light they communicate, to employ their knowledge and experience in the further advancement of the ſcience, and to grant them the tribute of praiſe in proportion to the merit of their reſpective performances, would be more conſiſtent with that candor and humanity which ought ever to be the inſeparable concomitants of philoſophy.

It is principally in the formation of orders that naturaliſts have ſo widely differed in their ſyſtems. Ignorant of the genuine relations of nature, they have been obliged to have recourſe to artificial diagnoſtics. In the claſs of quadrupeds, the characteriſtic ſigns are taken from the feet, from the teeth, the paps, the parts of generation, &c. There is ſtill a greater diverſity in the orders of birds, fiſhes, and inſects. Particular parts of the body are fixed upon, not becauſe theſe parts are pointed out by Nature as infallible marks of diſtinction or relation, but becauſe a perfect method, in the preſent ſtate of the ſcience, is impoſſible; and any method is preferable to confuſion.

ſion. It is vain, therefore, to diſpute about the propriety or impropriety of the aſſemblages in the orders of a Ray, a Linnæus, a Klein, or a Pennant. Till we acquire a more perfect knowledge of the hiſtory, as well as of the figure of animals, it is of little importance whoſe ſyſtem be adopted, provided the characters be clear, and all the facts that are at preſent known be diſtinctly related. Were every naturaliſt of the ſame ſentiments with regard to this point, many incumbrances with which natural hiſtory is now loaded would be removed; the ſtudent would not be diſtracted and retarded by an infinity of ſynonimes; the ſcience would become more ſimple and intelligible; and, of courſe, its bounds and the number of its votaries would ſoon be greatly augmented. I mean not that all attempts towards the perfection of ſyſtem ſhould be laid aſide; but that, in the preſent imperfect ſtate of the ſcience, it is to be regretted, that ſo much time and genius ſhould be expended in fruitleſs diſputes, and in the augmentation of methods and terms. To add to the number of facts and obſervations, to deſcribe with accuracy and preciſion, to ſeparate fiction from truth, to inveſtigate the œconomy and moral character of animals, and to render their utility to mankind more extenſive: Theſe are objects more worthy of the attention of philoſophers, more agreeable to ingenuous minds, and more correſpondent to the genius of the ſcience.

Nothing further need be ſaid with regard to the utility and defects of method in general. Obſervations of a more particular nature will occur in explaining ſome of the principal methodical arrangements. A ſhort view of the methods invented by ſyſtematic writers will make the reader acquainted with the different and ſucceſſive efforts towards the improvement of method, and give us an opportunity of unfolding more diſtinctly the reaſons by which we have

have been determined, in the following work, to adopt one in preference to all the reſt.

In moſt authors who have written profeſſedly upon the hiſtory of animals, attempts towards methodical arrangement may be diſcerned. Ariſtotle, Pliny, and Ælian perceived the utility of method. But they ſeem never to have dreamed of the practicability of teaching the ſtudent, by the help of a ſyſtem, partly natural, partly artificial, to inveſtigate the name, and, in many inſtances, even the nature and diſpoſitions of an animal he never ſaw before; or to be able, in a few minutes, to pronounce with certainty, that it had never hitherto been deſcribed by any author. This curious diſcovery was reſerved for a later and more ſcrutinizing age.

SECT. II.

An hiſtorical and characteriſtical Account of the writings and arrangements of the principal ancient and modern Naturaliſts.

I. Analysis of ARISTOTLE's History of Animals, with Remarks.

THERE are few people who have not at leaſt heard of the genius and learning of Ariſtotle. He was a pupil of Plato, and tutor to Alexander the Great. Among many other valuable performances, this great philoſopher compoſed a natural hiſtory of animals; a book, though written between two and three thouſand years ago, which contains a more thorough knowledge of the general relations of animals, with regard to manners, diſpoſitions, inſtincts, external and internal ſtructure, than at this day can be met with in many volumes. The philoſophic habit of his mind led him uniformly to general and expanded views; but his examples, which are conſtantly occurring, at the ſame time that they diſcover a minuteneſs and preciſion in the knowledge of Nature, convey ſolid inſtruction to the reader.

In the firſt book, Ariſtotle gives a general detail of the diſtinctions and analogies ariſing from the ſtructure and ſituation of the parts

parts of animals; their methods of living, their actions and manners; the organs neceſſary to animal life; the various modes of generating; the parts deſtined for motion; the principal genera, or claſſes, as quadrupeds, birds, fiſhes, and inſects, which laſt he ſubdivides into teſtaceous, cruſtaceous, and ſoft *. In the courſe of this inveſtigation, our author diſcovers that a number of animals, as man, the quadrupeds, birds, cetaceous fiſhes, &c. reſpire by means of lungs; and that theſe animals have likewiſe red blood in their veſſels; whereas inſects have no lungs, and their blood is tranſparent or colourleſs. He further diſcovers, that ſome produce live animals, and others eggs. Hence he deduces the following capital diſtinctions in the animal kingdom, namely, thoſe which have lungs, and thoſe which have no lungs; the ſanguineous and exſangueous; the viviparous and oviparous.

From the 9th to the 24th chapter, which finiſhes the firſt book, we have a conciſe anatomical deſcription of the external and internal parts of the human body.

The ſubject of the 2d, 3d, and 4th books, is a compariſon of the external and internal parts of quadrupeds, ſerpents, birds, fiſhes, and inſects, with regard to the difference of ſtructure in theſe animals compared with each other, and with man, whom the author had particularly deſcribed in the firſt book as a model or ſtandard. He concludes the 4th book with diſſertations on the ſenſes, the voice, ſleeping and watching, and the ſexes of animals.

The 5th and 6th books treat of generation and parturition, the number of young, and other circumſtances relative to this ſubject.

* Moluſca of Ray, Linnæus, &c.

Book 7th gives a particular account of the circumſtances preceding and following the generation of man, viz. puberty, the menſtrual flux, ſigns of conception, the time of geſtation, the number of young, the milk, the reſemblance of children to their parents, &c.

The firſt fifteen chapters of the 8th book contain a hiſtory of the food and manner of living of the different tribes of animals. From the 15th to the 24th, we have an account of ſuch animals as conceal themſelves at certain ſeaſons of the year, the migration of birds, and what animals renew their age by moulting, or by caſting their ſkin. From the 24th chapter to the end of the book, the author enumerates the diſeaſes of animals, the ſituations and circumſtances that are favourable to health or productive of diſeaſes, and the ſeaſons when they are moſt proper to be uſed for food.

In the firſt chapter of book 9th, the mental differences that take place in males and females are pointed out. The remainder of this book treats of the friendly or hoſtile diſpoſitions of certain animals to one another, and of their characters; it likewiſe contains ſome general deſcriptions and ſpecific diſtinctions.

From this ſhort view of the method and contents of Ariſtotle's hiſtory of animals, the general deſign of the author may be collected. He begun with inveſtigating the manners, diſpoſitions, and ſtructure of individuals. Ariſtotle was enabled to execute this important taſk to more advantage, perhaps, than any other perſon either before or ſince his time. Not to mention the extent of his own genius, Alexander provided him with live animals from every quarter of the then known world. Theſe were ſupported by the munificence

ficence of a monarch who merited the epithet of Great, not for the boundleſs ambition of his heart, not for the ſlaughter of millions of his own ſpecies, but for the protection and encouragement he afforded to the greater Ariſtotle.

After ſpending much time and labour in inveſtigating the characters and diſpoſitions of animals; after making repeated experiments in order to diſcover the ſecret ſprings of their actions, the extent of their capacities, their affections and averſions; after ſatisfying himſelf with regard to theſe and many other intereſting articles, Ariſtotle's next object was, how to digeſt thoſe materials ſo as beſt to promote the ſcience of nature. To give a particular deſcription and hiſtory of every individual neither correſponded with the genius of the author, nor with the ſtate of the ſcience at that time. To inveſtigate the relations and differences which ſerve to connect and diſtinguiſh the various tribes of animals, was the capital object of the learned author. Like the great Bacon, inſtead of retailing idle fictions, or facts founded only upon ignorance and credulity, Ariſtotle perceived the neceſſity of aſcertaining the genuine principles of the ſcience by actual experiments. Some idea may be formed of the number of thoſe experiments, and the judgment with which they were conducted, by the extenſive and accurate concluſions the author has drawn from them. Whoever reads Ariſtotle's hiſtory of animals with the ſame view with which he reads ſome modern authors will be greatly diſappointed. Trifling anecdotes, marvellous feats of ſtrength, ferocity, or cunning, addreſſed to the imagination in the language of declamation, are not to be expected in the works of an Ariſtotle.

His chief object was to reduce into a ſcientific form a branch of natural

natural knowledge, which had hitherto conſiſted only of a chaos of detached, uncertain, and often fabulous narrations and deſcriptions. The happy circumſtances in which he was placed, joined to the uncommon abilities with which this extraordinary perſon was endowed, enabled him to unfold the principles of natural hiſtory with ſuch amazing ſucceſs, that, to this day, no ſyſtem has been attempted, the principles of which have not evidently been derived from Ariſtotle. Analogies and diſtinctions are not only drawn from magnitude, figure, faculties and diſpoſitions of mind, but from the inſtruments of motion, the teeth, the eyes, the genitals, and, in a word, from every external and internal part of the body.

Having ſaid ſo much on what appears to be the nature and deſign of Ariſtotle's hiſtory of animals, it now becomes neceſſary to diſcloſe the principal intention of being ſo particular.

The eloquent M. de Buffon, and his learned and induſtrious friend M. Daubenton, declared enemies to methodical arrangement themſelves, betray a ſtrong inclination to preſs this illuſtrious ancient into their ſervice. They allege, that Ariſtotle, ſo far from having a deſign to eſtabliſh the *principles of ſyſtem*, ſhows a ſovereign contempt for methodical diſtribution, not only by the plan he has followed, but in different parts of the work itſelf; and yet, by way of compliment to the author, they ſay, "that it is neceſſary to go back "to the days of Ariſtotle for the general *principles of the diviſion of* "*animals*[1]." After mentioning the ſources from which Ariſtotle, in his firſt book, derives the diſtinguiſhing characteriſtics of different animals, theſe gentlemen inſiſt, that the author never meant them to be

[1] Hiſt. Nat. par Buffon, vol. 4. p. 142.

be the foundation of a modern nomenclature or ſyſtem, ſimilar to thoſe of Ray or Linnaeus

With regard to this we are perfectly agreed, but for a very different reaſon. Ariſtotle ſaw the perplexed ſtate of the ſcience, or rather perceived that the natural hiſtory of animals had not hitherto been reduced to a ſcientific form. He therefore applied the whole force of his mind towards the inveſtigation of general principles, to ſerve as a baſis for ſyſtem, and as a model for future writers. But, after the labour of many years, and encountering numberleſs difficulties, even making every allowance for the extent of his capacity and foreſight, it can hardly be ſuppoſed that Ariſtotle could ever conceive the poſſibility of a ſyſtem ſo perfect as either that of Ray or Linnaeus.

Buffon and Daubenton further allege, that Ariſtotle was too well acquainted with the nature of animals, to attempt a regular diviſion of them into claſſes, orders, genera, and ſpecies; that he only uſed generic terms in compliance with the ideas of the vulgar, who uniformly give the ſame name to objects endowed with ſimilar qualities; but that he formally proſcribes all ſubdiviſions of the genus, as being partly forced, partly impoſſible; and becauſe, in forming the different branches of thoſe ſubdiviſions, objects are ſeparated and diſperſed which ought always to be placed under one point of view: Beſides, that, in ſubdividing the genus, we are obliged to uſe negative characters: That Ariſtotle rejects negative characters, becauſe no diſtinctions or relations can be eſtabliſhed upon an idea of privation, and becauſe a thing which does not exiſt cannot be divided into ſpecies †.

This

* Hiſt. Nat. par Buffon, vol. 4. p. 143

† Ibid. vol. 4. p. 143. et ſeq.

This repreſentation of the ſentiments of Ariſtotle concerning methodical arrangement induced me to peruſe his hiſtory of animals with more than ordinary attention; and, if I am not greatly miſtaken, I have diſcovered the only reaſon which could induce the author to drop a few expreſſions which, at firſt view, ſeem to juſtify Buffon and Daubenton's opinion.

Whoever reads the book will ſoon perceive that the word *genus* is often uſed in the ſame ſenſe as *claſs* or *order* among the moderns; and ſometimes it is limited to the ſame idea that *we* affix to genus * This circumſtance frequently gives riſe to ambiguity.

Our author, as formerly obſerved, never intended to give a particular deſcription and hiſtory of every ſpecies. Man being the principal and beſt known animal in the creation, Ariſtotle takes him as a ſtandard, and deſcribes minutely his whole frame and movements. In deſcribing the inferior tribes of animals, he ſeldom deſcends to minutiae, but keeps chiefly in view their relations and diſcrepancies. Ariſtotle's book, therefore, is not a natural hiſtory of animals in the modern ſenſe of theſe words. It conſiſts only of philoſophical diſſertations on the general ſtructure, manners, and diſpoſitions of animated beings. If any perſon wiſhes to learn Ariſtotle's account of the lion, tiger, horſe, elephant, or any other animal,

* Sunt autem genera ſumma quaedam, quibus animalia diſtinguuntur. Sunt vero haec: *Unum* avium; alterum piſcium; tertium cetorum; quae omnia conſtant ſanguine. Eſt et *aliud* eorum genus, quae teſta contegnntur, quod oſtrea appellatur. Item *aliud*, quod molliore teſta operitur; caeterum nomine uno comprehenſum eſt; quales locuſtae et cancrorum genera quaedam, atque gammarorum. Praeterea aliud molluſcorum; cujuſmodi lolligines, et lollii, et ſaepiae. Poſtremo, inſectorum quoque *genus* eſt, quae omnia carent ſanguine.—*Ariſt. Hiſt. Animal. edit. Scaliger. lib.* 1. *cap.* 7. *et alibi paſſim.*

mal, he muſt peruſe the whole work before he can collect every thing the author has ſaid concerning them. His facts and obſervations are numerous; but, with regard to particular animals, theſe are not to be found in one place, nor in treating of an individual ſubject in the form of a continued hiſtory. On the contrary, his facts are always employed to ſupport the principles which he at the time is endeavouring to eſtabliſh.

To an author compoſing a book upon Ariſtotle's plan, therefore, a ſcrupulous ſubdiviſion of the different claſſes or genera could have anſwered no uſeful purpoſe. In eſtabliſhing or inveſtigating general principles, it is neceſſary to have a free and unlimited range through the whole circle of nature. Accordingly Ariſtotle, in treating of generation, the ſenſes, the inſtruments of motion, &c. inſtead of taking an individual for his ſubject, gives all the varieties that can be collected from the whole animal creation: And this conduct he uniformly purſues, whatever be the ſubject he is handling.

Such being the plan of our author, it ſurely cannot ſurpriſe any perſon to ſee him occaſionally obſerving, "that as many animals "are poſſeſſed of ſome common qualities, it is unneceſſary to treat "of theſe qualities as ſeparately exiſting in different ſubjects."

It is an obſervation as old as Pliny, that there is not any book from which a man may not learn ſomething: And it may likewiſe be obſerved, that, when a man reads with a view to ſupport a preconceived opinion, there is hardly any book in which he will not at leaſt imagine that he has found ſomething to his purpoſe. We will venture to affirm, that no man, who had not previouſly determined to condemn the methodical diſtribution of animals, could have ever

diſcovered that Ariſtotle had the ſmalleſt inclination to be of the ſame opinion. Inſtead of endeavouring to learn the general deſign of the book before us, were we, in imitation of Buffon and Daubenton, to pick out all the paſſages that actually favour methodical arrangement, this chapter would be enormouſly ſwelled with quotations.

§ 2. Of PLINY, the Elder.

After reading Ariſtotle, it is natural to expect that every ſucceeding writer upon the ſubject of animals would have either adopted his principles or endeavoured to improve them. But, on peruſing the works of the ſucceſſors of that great philoſopher, this expectation is by no means gratified. Ariſtotle demonſtrated the neceſſity of method and of accurate deſcription. But, inſtead of following his example, the very idea of method, whether natural or artificial, ſeems to have been almoſt entirely loſt for many centuries. Had the ancients been more explicit in their deſcriptions of natural bodies, their inattention to method might eaſily have been pardoned. But, with regard to this moſt eſſential article, they are ſo exceedingly defective, that it is often impoſſible to diſcover the ſubject of which they are treating. They ſuppoſe the reader to know every ſubſtance merely by the name they chuſe to give it. If any character by which the body may be diſtinguiſhed appears in their writings, it ſeems to eſcape from the author as it were by accident. Even when a deſcription is attempted, the permanent and eſſential characters are generally miſſed; and nothing but accidental and mutable characters, or, which is ſtill worſe, characters that equally belong to other ſubſtances, are exhibited. Nay, in deſcribing ſpecies, the characters of the

the genus itſelf are often totally omitted *. Were it difficult to demonſtrate the utility of methodical diſtribution by arguments of a different nature, it would be ſufficient to refer the oppoſers of method to the ancient writers of natural hiſtory, to ſhew how much confuſion and ambiguity the want of ſuch diſtribution occaſions.

But, although the ancient naturaliſts were not ſo attentive to method and accuracy of deſcription as could be wiſhed, we muſt not therefore ſuppoſe them to be deſtitute of merit. On the contrary, their writings are diſtinguiſhed by a grandeur and elevation of ſentiment which few moderns have been able to reach. Deſpiſing every thing that appears to be trifling or inſignificant, they exalt our ideas of nature, and are particularly ſollicitous to ſhew that all her productions anſwer ſome uſeful purpoſe to mankind.

The want of method and preciſion of deſcription is peculiarly to be regretted in the works of the learned and laborious Pliny. His genius was too comprehenſive to be limited to any branch of natural hiſtory. His ideas of this ſubject were not confined to animals, vegetables, and minerals, but extended to every production of Nature exhibited either in the heavens or the earth. Agreeably to theſe ideas, Pliny's Hiſtory of Nature, beſides a hiſtory of the animal, vegetable, and mineral kingdoms, comprehends an abridgement of all that the ancients knew in geography, aſtronomy, botany, agriculture, gardening, medicine, the liberal arts, &c. His ſtyle is conciſe, nervous, and elevated. His knowledge is profound, and his method of reaſoning clear and philoſophical. But, as it is foreign to our preſent deſign, to give an account of Pliny's manner

* Vid. Plin. Hiſt. Nat. cap. 8. et alibi paſſim.

of treating every ſubject, we ſhall confine ourſelves to his hiſtory of animals.

Pliny, in this part of his work, begins with man. He does not, however, like Ariſtotle, give a deſcription of the ſtructure of the human body. His chief objects are the external figure of men, the diſpoſitions, manners, and cuſtoms of different nations. Here our author diſcovers an extenſive erudition, and a deep knowledge of human nature.

A ſtrange mixture of character, however, appears in moſt parts of Pliny's writings. A mind ſtored with every ſpecies of literature, a refined taſte, a ſceptical ſcrutinizing temper, combined with a conſiderable portion of ſuperſtition and credulity. He gravely tells us of a certain northern nation, called Arimaſpi, who have but one eye in the middle of their foreheads; of a country inhabited by wild men with their feet behind their heels; of a nation of hermaphrodites mutually impregnating each other; of a people with a couple of pupils in each eye; of a ſpecies of men with dogs heads; of another ſpecies with eyes in their ſhoulders; of a third ſpecies who have no mouths, and are nouriſhed ſolely by ſmelling, &c. A number of extravagancies of this kind are to be found in the ſecond chapter of the 7th book. Pliny indeed generally quotes his authorities for ſuch abſurdities; but, from his manner of writing, and his arguments in favour of this ſpecies of credulity contained in the firſt chapter of the ſame book, it is plain, that he firmly believed, or at leaſt means that his readers ſhould believe, moſt of thoſe ridiculous chimeras.

After mankind, Pliny treats of land-animals, as diſtinguiſhed from

from aquatics. In this part of his ſubject he obſerves not the leaſt veſtige of order. It is a mere jumble of quadrupeds, ſerpents, frogs, lizards, &c. Next follow the aquatic animals; then the birds; and, laſtly, the inſects. The order in which theſe laſt claſſes are treated is exactly of a piece with that in the firſt claſs. Beſides, he even mixes and confounds the very order which he ſeems to follow [*].

Upon the whole, notwithſtanding Pliny's deficiencies with regard to method and deſcription, his hiſtory contains the greateſt part of the natural knowledge of the ancients, compiled indeed from other authors, but managed with ſuch taſte and addreſs, that the whole has the appearance of an original compoſition.

§ 3. Of ÆLIAN.

This author was a Roman, and lived under the Emperor Adrian. He was, however, ſo fond of the learning of the Greeks, that, in his compoſitions, he preferred their language to his own. Though he has written upon other ſubjects, he acknowledges, that his genius had a peculiar bias towards natural hiſtory. He therefore choſe that ſubject for his principal work, which he entitled, *Of the Nature of Animals.*

The work is divided into ſeventeen books: Theſe diviſions do not reſult from the nature of the compoſition, but ſeem to have been made merely for the conveniency of the reader. Ariſtotle, as a natural hiſtorian, aſtoniſhes us with extent of knowledge and depth of penetration: The amiable Ælian addreſſes himſelf, in the gentleſt manner,

[*] Vid Plin. Hiſt. Nat. lib. 8. 9. 10. 11.

manner, to our reaſon and imagination, warms our hearts with the love of virtue, and excites a ſovereign contempt of every action or ſentiment beneath the dignity of our nature.

Ælian's favourite aim was, to rouſe the ſentiments and enforce the practice of genuine morality. Arguments drawn from the beauty of virtue and the deformity of vice were as common and as ineffectual in his days as in ours. He therefore laid hold of another and more powerful principle of human nature. Being well acquainted with the manners and diſpoſitions of the animal creation, inſtead of painting human heroes and human miſcreants, Ælian ſtimulates our pride by the generoſity, friendſhip, gratitude, courage, meekneſs, reſignation, modeſty, parental affection, and temperance, exhibited in the characters of particular animals; and excites our averſion by the illiberality, ſelfiſhneſs, ingratitude, puſillanimity, ferocity, impatience, obſcenity, unnaturality and gluttony, diſplayed in the diſpoſitions of others.

In compoſing a book with this view, we cannot ſuppoſe that the author would find it neceſſary to cramp himſelf with a ſtrict connection in the different parts of his work, far leſs to write in the form of a ſyſtem. Ælian's whole book, on the contrary, conſiſts of unconnected anecdotes concerning animals, either derived from his own experience or collected from the writings of others. In the 37th chapter of the eleventh book, however, he has occaſionally collected Ariſtotle's principles of the diviſion of animals, and reduced them into ſuch order as would make no contemptible figure in a modern ſynopſis. Ariſtotle's chief attention was directed to the external and internal ſtructure of animals, in order to aſcertain the principles and facilitate the ſtudy of natural hiſtory. Ælian ſteers an oppoſite courſe.

courſe. He ſeldom or never takes notice of external forms or qualities, but confines himſelf entirely to mental character and diſpoſitions. It requires no depth of penetration to diſcover many anecdotes which have the air of fable and credulity: But a reader endowed with a moderate ſhare of good nature will find little difficulty in pardoning faults of this kind. The author has enriched his work with a multitude of genuine and unconteſted facts. If he ſometimes relates ſtories that require more faith than his reader is poſſeſſed of, he generally either quotes his authority, or gives a hint that he does not believe them himſelf. Beſides, in many ſtories of this kind, it is eaſy to perceive that the moral is Ælian's principal object.

§ 4. Of OPPIAN.

Oppian was a native of Cilicia, and flouriſhed under the Emperors Severus and Antoninus Caracalla. He compoſed two excellent poems in the Greek language, and preſented them to Antoninus, who was ſo delighted with them that he recalled Ageſilaus, Oppian's father, from baniſhment, and farther rewarded the author with a piece of gold for every verſe. The ſubjects of thoſe poems are fiſhing and hunting. Though Oppian died in his 30th year, his poems diſcover a brilliancy of genius, a correct taſte, a maturity of judgment, and a compleat knowledge of ancient learning. Natural hiſtory, however, ſeems to have been his favourite ſtudy. In his poem on fiſhing, a vaſt variety of fiſhes are deſcribed with ſurpriſing accuracy and minuteneſs; and, in the poem upon hunting, the principal quadrupeds are painted in lively colours. Oppian does not, however, confine himſelf to deſcription alone: He frequently gives a pretty

compleat

compleat hiſtory of the manners, diſpoſitions, and œconomy of the different animals introduced in his poems. Although, from the nature of the performance, we cannot expect that the author ſhould write in a ſyſtematic ſtrain; yet he diſcovers an intimate acquaintance with the principles upon which ſyſtem is founded. It is remarkable, that Oppian, though poſſeſſed of a warm poetical fancy, has rejected moſt ſtories that favour of fiction and credulity.

§ 5. Of GESNER.

Conrad. Gesner, a phyſician at Turin, publiſhed a natural hiſtory of animals in the year 1551-58, conſiſting of four large volumes in folio. The ſubdiviſions of his claſſes are entirely regulated by the letters of the alphabet, and conſequently deſerve no further notice. He indeed makes an apology for this conduct. He allows that methodical diſtribution is more philoſophical; but he prefers the alphabetical arrangement on account of his numerous philoſophical obſervations, which he conſiders as the moſt valuable part of his work. As this author has collected every thing that had been ſaid upon animals by ancients and moderns, by poets, philoſophers, phyſicians, ſhepherds, grammarians, &c. in all countries and languages, his work may be of uſe to ſome readers; but his prolixity is inſufferable, particularly his philological diſcuſſions. In a word, Geſner's natural hiſtory may be conſidered as a rude quarry from which ſome valuable ſtones may be dug; but the labour of removing the rubbiſh overbalances their intrinſic worth. In the hiſtorical part, there are many valuable anecdotes, blended with a variety of fabulous impertinences.

§ 6.

§ 6. Of WOTTON.

In the hiſtory of particular ſciences, there appears, at certain periods, a ſtrange inattention to facts and principles previouſly diſcovered. Ariſtotle, above two thouſand years ago, unfolded the principles of natural hiſtory in the moſt ſimple and perſpicuous manner. But the ſpirit and deſign of his book were either never fully underſtood or unaccountably neglected by all the ſubſequent writers upon this ſubject, till towards the middle of the 16th century.

At this period, there aroſe, in different parts of Europe, ſeveral learned and ingenious naturaliſts, who perceived that all animated beings were connected by certain mutual relations; that theſe relations had been too much neglected by preceding authors: and that this inattention to the order and concatenation of objects was the principal reaſon why the knowledge of nature was ſo little cultivated, and ſo difficult to be attained. Methodical arrangement, therefore, became a capital object of attention; and moſt writers after this period were more or leſs ſucceſsful in their arrangements, according to the acuteneſs of their obſervation, and the extent of their capacities.

Edward Wotton, a phyſician at Oxford, compoſed a volume upon the diſtinguiſhing characteriſtics of animals, which was publiſhed at Paris in the year 1552, and inſcribed to Edward VI. King of England *.

He begins with an enumeration of the peculiar qualities by which

* Edwardi Wottoni Oxonienſis de differentiis animalium libri decem. Lutetiæ Pariſiorum 1552.

the various ſpecies of animals are diſtinguiſhable from each other: Theſe diſtinctions are derived from a multiplicity of circumſtances; from the ſenſes, external and internal parts, the food, affections and averſions, manners, colour, actions, inſtruments of motion, the elements in which they live, their modes of generating and producing, &c. Having executed this part of the work with great judgment and learning, Dr Wotton proceeds to give a more particular account of the genera and ſpecies, which he claſſes in the following manner:

I. Sanguineous, or animals with red blood.
II. Exangueous, or animals with tranſparent or colourleſs blood.

The firſt claſs is divided into five orders, viz. 1. Man, as being the head of the animal creation. 2. Viviparous quadrupeds. 3. Oviparous quadrupeds and ſerpents. 4. Birds. 5. Fiſhes.

The ſecond claſs he divides into two orders, viz. 1. Inſects. 2. Exangueous aquatic animals.

The viviparous quadrupeds are ſubdivided into, 1. Digitated, or toed, as apes, dogs, &c. 2. Cloven-hoofed, as the cow, the ſheep, &c. 3. Whole-hoofed, as the horſe, the aſs, &c. Under oviparous quadrupeds are comprehended frogs, lizards, &c. Serpents are added on account of their ſimilarity.

The birds are ſubdivided into, 1. Fidipedes, or ſuch as have unconnected toes, as the gallinaceous kind, &c. 2. Carnivorous, as the eagles, vultures, &c. 3. Aquatic birds, which are again diſtinguiſhed into ſuch as frequent the ſhores and marſhy places, as the cranes, the ſnipes, &c. and ſuch as are web-footed, as ducks, &c.

The

The fiſhes are ſubdivided into, 1. Cartilaginous, plain, oblong, and long. 2. Saxatiles, or thoſe which frequent ſtony places. 3. Cetaceous, or the whale-kind.

The inſects are ſubdivided into, 1. Such as build neſts or combs, as the bee, waſp, &c. 2. Such as are furniſhed with a proboſcis. 3. Such as have their wings incloſed in a cruſtaceous ſheath, as beetles, &c. 4. Caterpillars.—To the arrangement of the inſects, our author ſeems to have paid leſs attention than to that of the other orders of animals; for he has not availed himſelf of many excellent diſtinctions which he had pointed out in the beginning of his ninth book.

The exangueous aquatic animals are ſubdivided into, 1. Soft, as the cuttle-fiſh, &c. 2. Cruſtaceous, as lobſters, crabs, &c. 3. Teſtaceous, or ſhell-animals. 4. Zoophyta, as the ſpongia, &c.

Dr Wotton's deſcriptions are not only conciſe and elegant, but the œconomy and diſpoſitions of the different animals are painted in a lively and entertaining manner. His taſte in compoſition is chaſte and unaffected. Though well acquainted with the writings of the ancients, he does not encroach on the patience of his readers, or augment the ſize of his book, by unneceſſary and tedious quotations.

§ 7. Of BELONIUS.

Petrus Belonius publiſhed a volume de Aquatilibus, at Paris, in the year 1553. Under aquatic animals, Belonius comprehends the cetaceous fiſhes, the hippopotamus, the otter, the water-rat, and

other amphibious animals. He divides the whole into two orders, viz. the Sanguineous and Exangueous. The ſanguineous he ſubdivides into viviparous, as the whale, the dolphin, the hippopotamus, &c. Oviparous, as the crocodile, &c. Cartilaginous, which laſt he again ſubdivides into viviparous and oviparous, ſpinous, broad, and oblong fiſhes; fiſhes which reſemble ſerpents; and what he calls the leſſer ſpinous, ſcaly fiſhes, which he diſtributes into pelagii, or fiſhes found only at great diſtances from the ſhores; littorales, or thoſe which frequent the ſhores; ſaxatiles, or thoſe which frequent rocks and ſtony places; and, laſtly, the amnici and lacuſtres, or thoſe found in rivers and lakes.

In the 1555, Belonius, or Belon of Maine, publiſhed another volume upon birds, which he arranges in the following manner:

Order I. Rapacious birds, both diurnal and nocturnal, as eagles, vultures, owls. II. Water-fowl, or thoſe which are web-footed, and ſwim in water, as the ſwan, pelican, ducks, &c. III. Birds which frequent banks of rivers, and marſhy places, and are not web-footed, as the crane, the heron, &c. IV. Land-fowl, which build their neſts upon the ground, as partridges, &c. V. Birds which frequent almoſt every place, and which live upon different kinds of food, as crows, pies, parrots, woodpeckers, &c VI. Small birds which build their neſts in hedges and buſhes: Theſe are ſubdivided into inſectivorous, granivorous, and ſuch as feed indifferently either upon inſects or grain.

The author diſcovers an extenſive knowledge of his ſubject, and a tolerable taſte in compoſition, which is more conciſe, leſs embar-

raſſed

raſſed with quotations, and the ideas are clearer and better arranged than in the writings of moſt of his cotemporaries.

§ 8. Of RONDELETIUS.

In the year 1554, Rondeletius, a profeſſor of medicine at Montpelier, publiſhed a work, De Piſcibus. The firſt four books are entirely occupied with the diſtinguiſhing characters of fiſhes. Thoſe characters are taken from the external and internal figure of the parts; from the manners and diſpoſitions; from the food, the places frequented by different kinds, and many other circumſtances. He diſtributes all fiſhes into two orders, viz. I. Sanguineous II. Exangueous. The fiſhes comprehended under the firſt order are ſubdivided into, 1. Broad, compreſſed, ſcaly fiſhes, as the aurata, ſparus, &c. 2. Saxatiles. 3. Small fiſhes. 4. What the author calls the lizard-kind, as the acus, &c. 5. Round, uncompreſſed, ſcaly fiſhes, as the lupus, aſellus, &c. 6. Fiſhes ſtill rounder than the former, of a reddiſh colour, and having a thick head, as the mullet, milvus, &c. 7. Plain fiſhes, not cartilaginous, as the ſoal, &c. 8. Plain cartilaginous fiſhes, as the raiæ, &c. 9. Long fiſhes, as the conger, &c. 10. Foreign fiſhes, as the orbs, &c. 11. Cetaceous fiſhes, as the whale, &c.—The ſecond order, viz. the exangueous, he divides into, 1. Teſtaceous, or ſhell-fiſh, which conſiſt either of one or a double ſhell. 2. Turbinata and cochleæ. 3. Inſects and zoophytes.

Rondeletius was ſo fully convinced of the neceſſity of methodical arrangement, that he frequently mentions the impoſſibility of diſtinguiſhing one object from another, without having recourſe to the various

rious marks by which the productions of Nature are characteriſed *. The firſt fiſh he deſcribes is the aurata; but he anxiouſly guards his reader from imagining that he does ſo becauſe the name of the animal begins with the letter A †. Rondeletius deſcribes with accuracy and fidelity: His taſte in compoſition is ſtill more chaſte than that of Belonius.

§ 9. Of SALVIANUS.

Hippolytus Salvianus, a profeſſor of medicine at Rome, publiſhed, in the year 1557, a large folio volume, entitled, Aquatilium Animalium Hiſtoria. This book contains the deſcription and hiſtory of about 100 fiſhes, with figures drawn from the life, and engraved on copperplate with ſurpriſing taſte and elegance. As the author confined himſelf entirely to ſuch fiſhes as he had ſeen and examined, it was unneceſſary for him to diſcover any ſolicitude about ſyſtematic arrangement. His deſcriptions are minute and accurate; but the reader is frequently embarraſſed and interrupted with uſeleſs quotations from the antients.

§ 10.

* Quid enim eſſet aliud inter nos quam chaos quoddam et rerum omnium confuſa congeries, niſi forma, colore, aliiſque hujuſmodi internoſcerentur? Quo pacto lapides, herbæ, piſces, a ſeſe diſcernerentur, ſi per omnia ſimiles ſibi ipſis eſſent? Ne illa quidem linguarum confuſio in Babel tantum unquam negotii exhibuit, quantum illa rerum omnium ſimilitudo exhibuiſſet! Rondelet. de piſc. lib. 2. p 31.

† Nolim autem quemquam exiſtimare, ideo nos Auratam primum depingere, quod ab A litera incipiat. Hunc enim ordinem per literarum elementa, non minus in piſcium quam in herbarum deſcriptionibus, vitioſum eſſe exiſtimamus; et hunc ſecutos jure quidem a Dioſcoride reprehenſos fuiſſe. Rondelet. de piſc. lib. 5. p. 113.

§ 10. Of ALDROVANDUS.

Ulysses Aldrovandus practiſed as a phyſician at Bononia in Italy. He wrote a ſyſtem of natural hiſtory conſiſting of 12 folio volumes. Several of them were publiſhed after his death, which happened about the end of the 16th century. This voluminous author was ſo ſenſible of the abſurdity of attempting to communicate ſcience without method, that he expreſſes a degree of indignation againſt many of his predeceſſors, who, for want of genius to diſcover even the moſt obvious relations of nature, had recourſe to an alphabetical arrangement*

Aldrovandus diſtributes the animal kingdom into ſix claſſes, viz. I. Quadrupeds. II. Serpents. III. Birds IV. Fiſhes. V. Inſects. VI. Exangueous animals, or animals with colourleſs blood.

I. Quadrupeds.

These he ſubdivides into three orders. 1. Whole-hoofed. 2. Cloven-hoofed. 3. Digitated or toed.

In the firſt order, viz. the whole-hoofed animals, he begins with the horſe, becauſe he is the moſt uſeful to mankind; then follow the aſs, the mule, the unicorn, and the elephant.

The

* Qui alphabeticum in ſcientiis ordinem ſecuti ſunt, ut Paulus Ægineta, Avicenna, &c. ſemper mihi diſplicuerunt, quod, rerum ſpecies commiſcentes, quæ ſimilis naturæ ſunt, ideoque conjungenda, diſtrahant; quæ vero plurimum a ſe mutuo diſcrepant, ideoque diſtinguenda, contra connectant, Naturæ ordinem turbant, ſcientiorumque methodum omnem invertant, ac confundant. Aldrov. Ornithol. p. 7.

The ſecond order conſiſts of the cow, bull, and ox; the urus, bonaſus, buffalo, ſheep-kind, goat-kind, rhinoceros, camel, camelopard, and ſow.

The third order is ſubdivided into viviparous and oviparous. The viviparous are again ſubdivided into feræ, or ſavage animals; ſemiferæ, or wild animals; and domeſtic animals. Under feræ are arranged, the lion, lynx, tiger, bear, wolf, &c. The ſemiferæ comprehend the fox, ape-kind, caſtor, &c. And under domeſtic are contained the dog and cat.—The oviparous, as the frog, the toad, lizards, &c. are placed laſt becauſe of their ſtupidity and want of dignity.

II. Serpents.

They are divided into two orders: 1. Thoſe who have no feet. 2. Thoſe who have feet.

III. Birds.

These are arranged into three orders: 1. Rapacious. 2. Granivorous. 3. Aquatic birds, and thoſe who frequent the ſhores.

The rapacious, or birds with crooked claws, and generally carnivorous, he ſubdivides into, 1. Diurnal, who ſeize their prey in the day, as the eagles, hawks, and falcons. And, 2. Nocturnal, who prey during the night, as the owl, the bat, &c. Here he ſubjoins the parrot tribe, on account of the general ſtructure of their bodies, and becauſe they eat fleſh when in a domeſtic ſtate.

The

The granivorous comprehends the peacock, turkey, pheaſants, and partridges. Here he makes two ſubdiviſions; 1. The baccivorous, or berry-eaters, as the thruſh, the ſtarling, &c. 2. The vermivorous, or inſect-eaters, as the ſwallows, motacilla, &c. He ſubjoins a ſection upon ſinging birds, as the nightingale, lark, goldfinch, &c.

The aquatic birds are divided into, 1. Web-footed, as the ſwan, pelican, ducks, &c. 2. Littoral, or thoſe which frequent ſhores, banks of rivers, and marſhy places, as the ſtork, the cranes, the woodcock, &c.

IV. Fishes.

Theſe our author arranges into ſix orders: 1. Saxatiles, or thoſe which frequent ſtony places. 2. Littorales, or thoſe found near the coaſts. 3. Pelagii, or ſuch as are only found at great diſtances from the ſhores. 4 Thoſe which both frequent the ſea and rivers. 5. River-fiſh. 6. Whales, or cetaceous fiſhes.

V. Insects

This claſs conſiſts of two orders: I. Terreſtrial. II. Aquatic. The firſt order is divided into inſects with feet, and inſects without feet. The inſects furniſhed with feet are again ſubdivided into, 1. Thoſe with, and thoſe without, wings. 2. Inſects having elytra, or whoſe wings are ſheathed in a cruſtaceous covering, as the beetles, &c. and inſects which have no elytra. 3. Naked-winged inſects have either (1.) four membranaceous wings, as the bee, the waſp, &c. or, (2.) four farinaceous wings, as the butterflies, &c. 4. Two-winged inſects, as the domeſtic fly, &c. Inſects without wings are

divided into, 1. Thoſe which have few feet, i. e. from 6 to 14, as the ant, the ſcorpion, &c. 2. Thoſe which have many feet, as the millipes, &c.—There is no ſubdiviſion of the inſects that want feet, as the earth worm, &c.

The ſecond order, or aquatic inſects, is likewiſe divided into thoſe which have feet; as the muſca fluviatilis, and thoſe which have no feet, as the leech, &c.

VI. Exangueous.

Theſe are divided into, 1. Soft, as the cuttle-fiſh, &c. 2. Cruſtaceous, as lobſters, crabs, &c. 3. Teſtaceous, or ſhell-fiſh. 4. Zoophyta, as the pulmo marinus, &c.

This diſtribution of animals, though inaccurate in many reſpects, is by no means contemptible. Aldrovandus's principles of arrangement are numerous, but they are frequently unphiloſophical. For example, in the claſs of fiſhes, the principle of arrangement, inſtead of being derived from qualities peculiar to the animals themſelves, is taken ſolely from the places which they moſt commonly frequent. What he ſometimes calls dignity, ſometimes utility, ſometimes genius, or mental abilities, is another principle of diviſion which he attempts to follow through all his claſſes. This often leads him into an unneceſſary train of ridiculous argument, in ſettling the precedency of animals, whoſe hiſtory is ſtill too little known to admit of ſuch reaſoning.

With regard to the execution of the work itſelf; the deſcriptions are in general good. The hiſtorical part is frequently debaſed with fable

fable and credulity. The manner of writing is deeply marked with the falſe taſte of the age in which the author lived; and the whole is enormouſly ſwelled with long quotations from poets, grammarians, and commentators, and other ſuperfluous matter.

§ 11. OF JONSTON.

Dr John Jonſton a phyſician at Leſzno in Poland, publiſhed a ſyſtem of Natural Hiſtory at Amſterdam, in the year 1657. This author's chief aim was, to give an abridgement of the voluminous works of Geſner and Aldrovandus: He has likewiſe added the American animals from Margraaf and Piſo. He digeſts the whole into five general claſſes. I. Quadrupeds. II. Birds. III. Fiſhes. IV. Inſects. V. Serpents. He firſt publiſhed the fiſhes, next the birds, then the quadrupeds, and, laſtly, the inſects and ſerpents.

The quadrupeds are arranged into the following orders: 1. Whole-hooſed. 2. Cloven-hooſed; which laſt are ſubdivided into ruminating animals with, and without horns, and ſuch as do not ruminate. 3. Digitated viviparous animals, which are either terreſtrial or aquatic; and digitated oviparous animals, which are either covered with ſhells, or have no ſhells.

There are two orders of birds: 1. Land-fowls. 2. Water-fowls. The firſt order is ſubdivided into carnivorous; granivorous which do not ſing; granivorous ſinging birds; inſectivorous that do not ſing; and inſectivorous ſinging birds. The ſecond order is ſubdivided into, web-footed aquatic birds, which feed upon fiſhes; web-

footed herbivorous birds; carnivorous, inſectivorous, and herbivorous aquatic birds, with divided toes.

The claſs of fiſhes is ſubdivided into the following orders: 1. Pelagii. 2. Saxatiles. 3. Littorales marini. 4. Fiſhes which frequent both rivers and the ſea. 5. Fiſhes which live only in rivers and lakes.

The orders of inſects are, 1. Terreſtrial inſects furniſhed with wings and feet. 2. Terreſtrial inſects which have feet, but not wings. 3. Terreſtrial inſects without feet. 4. The exangueous, which are ſubdivided into ſoft, cruſtaceous, and teſtaceous. 5. Zoophytes.

The ſerpents are diſtinguiſhed into terreſtrial, aquatic, and dragons without and with wings.

Dr Jonſton has conſiderable merit in abridging the enormous volumes of Aldrovandus and Geſner: His merit would have been ſtill greater, if, inſtead of abridging, he had totally rejected the accounts of many fictitious animals deſcribed and painted by theſe authors.

§ 12. Of WILLOUGHBY.

Francis Willoughby, Eſq; was the only ſon of Sir Francis Willoughby of Middleton in the county of Warwick. His amiable character, both as a gentleman and ſcholar, may be ſeen in Mr Ray's preface to the tranſlation of Willoughby's Ornithology, publiſhed in the year 1678. Mr Willoughby died in July 1672, when he

he was only in the 37th year of his age. After his death, Mr Ray having examined his manuſcripts, found the quadrupeds, birds, fiſhes, and inſects digeſted into a new method, but few of their deſcriptions and hiſtories ſo perfect as the author had intended. Thoſe defects, however, were afterwards ſupplied, at leaſt with regard to the birds and fiſhes, and publiſhed by Mr Ray himſelf. The ornithology appeared in Latin in the year 1676, and the hiſtory of fiſhes in the 1686, each of them accompanied with copperplate figures of the different ſpecies.

The deſign of the author cannot be better repreſented than in the words of Mr Ray: 'As for the ſcope of this undertaking, it was 'neither the author's, nor is it my intention, to write pandects of 'birds, which ſhould compriſe whatever had been before written of 'them by others, whether true, falſe, or dubious, that having been 'abundantly performed by Geſner and Aldrovandus. But our main 'deſign was to illuſtrate the hiſtory of birds, which is in many par-'ticulars confuſed and obſcure, by ſo accurately deſcribing each 'kind, obſerving their characteriſtic and diſtinctive notes, and re-'ducing all to their proper claſſes and genera, that the reader might 'be ſure of our meaning, and, upon comparing any bird with our 'deſcription, not fail of diſcerning whether it be the one deſcribed, 'or no *.'

But the juſtneſs of Mr Willoughby's ideas concerning the methodical diſtribution of animals will ſtill further appear from the following ſketch of his plan.

BIRDS.

* Preface to the tranſlation of Willoughby's Ornithol.

Birds.

These our author comprehends under two general diviſions, viz. 1. Land-fowl. 2. Water-fowl.

The land-fowl are diſtinguiſhed into, 1. Birds with crooked bills and talons. 2. Birds with more ſtraight bills and claws.

Thoſe with crooked bills or talons are either, 1. Carnivorous and rapacious; or, 2. Frugivorous. 1. The carnivorous are ſubdivided into diurnal and nocturnal. The diurnal are again divided into the leſſer, and the greater. The greater diurnal birds are ſtill further divided into the more generous, called eagles; and the more cowardly and ſluggiſh, called vultures. The leſſer diurnal birds are in the ſame manner diſtinguiſhed into the more generous, called hawks, and which are capable of being taught to fowl; and the more cowardly and ſluggiſh, which, from their want of docility, are neglected by falconers. The generous are again diſtinguiſhed into long-winged, as the falcon, lanner, &c.; and ſhort-winged, as the goſhawk and ſparrow-hawk. The cowardly are divided into the greater, as the common buzzard, bald-buzzard, &c; and the leſſer, which is again divided into the European, as butcher-birds and ſhrikes; and the exotic, or birds of Paradiſe. The nocturnal are either horned, as the eagle-owl, horned-owl, &c.; or without horns, as the crown owl, gray owl, &c. 2. The Frugivorous are diſtinguiſhed into the greateſt kind, called macaws; the middle-ſized, called parrots; and the leaſt kind, called parroquets.

Birds with more ſtraight bills and claws are divided into the greateſt,

eſt, which, on account of the bulk of their bodies and ſmallneſs of their wings, cannot fly, as the oſtrich, the caſſiowary, and the dodo; the middle ſized; and the leaſt kind. The middle ſized are divided into ſuch as have large, thick, ſtrong, and long bills; and ſuch as have ſmaller and ſhorter bills. The large billed feed either promiſcuouſly upon fleſh, inſects, and fruits, and thoſe again are either wholly black, as the crow-kind, or party-coloured, as the pie-kind; upon fiſh, as the kings-fiſher, or upon inſects only, as the wood-peckers. The middle-ſized are diſtinguiſhed, by the colour of their fleſh, into the white, as the poultry-kind; and the black, which are again ſplit into the greater, as the pigeon-kind; and the leſſer, as the thruſh-kind. The leaſt kind, called ſmall birds, are diſtinguiſhed into the ſoft-beaked, or thoſe which have ſlender, ſtraight, and generally pretty long bills, and feed upon inſects; and the hard-beaked, or thoſe which have thick and ſhort bills, and feed moſtly upon ſeeds.

Birds of the ſecond diviſion, water-fowl, are diſtinguiſhed into, 1. Such as frequent waters and watery places, in queſt of their food. 2. Such as ſwim in water.

Thoſe that frequent watery places are divided into the greateſt, as the crane, jabiru, &c.; and the leſſer; which laſt is again diſtinguiſhed into piſcivorous, as the heron, ſpoon-bill, ſtork, &c.; and mudſuckers and inſectivorous. The mudſuckers have very long bills, which are either crooked, as the curlew, whimbrell, &c. or ſtraight, as the wood-cock, godwit, &c. middle-ſized bills, as the ſea-pie, redſhank, &c. or ſhort bills, as the lapwing and plover.

Thoſe that ſwim in the water are divided into cloven-footed, as the coot, &c. or whole-footed. The whole-footed are either

either long-legged, as the flammant, the avoſetta, &c. or ſhort-legged, which laſt are ſubdivided into ſuch as have three toes, as the penguin, the razor-bill, &c. and thoſe with four toes. The four-toed are again diſtinguiſhed into ſuch as have all the four toes connected by membranes, as the pelican, the ſolan-gooſe, &c. and ſuch as have the back-toe looſe; and theſe laſt are ſubdivided into narrow-billed, and broad-billed. The narrow billed are diſtinguiſhed into ſuch as have blunt bills, hooked at the point, which are either ſerrated, as the diver, or not toothed, as the puffin, &c.; and ſuch as have ſharp-pointed and ſtraighter bills, which again are either ſhort-winged and divers, called duckers; or long-winged, and much upon the wing, called gulls. The broad-billed are divided into the gooſe-kind, which are larger; and the duck-kind, which are leſſer; and theſe laſt are either ſea-ducks, that dive much; or river and plaſh-ducks.

FISHES.

Order I. Cetaceous fiſhes, or thoſe which have lungs, are viviparous, and ſuckle their young, as the whale, the dolphin, the porpoiſe, &c.

Order II. Cartilaginous fiſhes, which are viviparous, have no ſcales, and, in place of gills, have on each ſide five oblong holes; have cartilages inſtead of bones; and the males have two appendages connected with the anal fins, which are thought to be mentulae.

The ſecond order, viz. The cartilaginous fiſhes, are divided into the proper, and leſs proper.

The

The proper are ſubdivided into long and cylindrical, and broad and plain fiſhes. The long cylindrical are diſtinguiſhed into ſuch as have longer, and ſuch as have ſhorter ſnouts: Thoſe with longer ſnouts are divided into ſuch as have teeth, and are either deſtitute of prickles, as the white ſhark the blue ſhark, the ſea-fox, the balance-fiſh, &c.; or furniſhed with prickles, as the hound-fiſh, &c.; and ſuch as have no teeth, as the ſmooth hound-fiſh, &c.: Thoſe with ſhorter ſnouts, as the bounce, &c. are not ſubdivided. The broad and plain fiſhes are ſubdivided into thoſe with thinner tails, and thoſe with thicker tails. The thinner-tailed are either furniſhed with a ſpinous ray, as ſome of the ſea-eagles, &c. or with many prickles, which laſt are again divided into thoſe that are rough, as the white-horſe, thorn-back, &c.; and thoſe which are ſmooth, as the ſkate-fiſh, &c.

The leſs proper cartilaginous fiſhes have cartilage in place of bone, are ovipaṛous, and furniſhed with gills, but have no mentulae; as the frog-fiſh, &c.

Order III. Spinous oviparous fiſhes, or thoſe which, for the moſt part, have prickles adhering to their bodies.

This order is divided into,

1. Plain ſpinous fiſhes, which project themſelves on their ſides when ſwimming and are either ſhorter and more ſquare, as the turbot, or longer, as the ſole, &c.

2. Eel-ſhaped fiſhes, as the conger, the ſea-ſerpent, &c.

3. Fiſhes with more contracted bodies, and which have no belly-fins, as the orb, the ſun-fiſh, &c.

4. Fiſhes with ſoft and flexible rays in the back fins, which are divided into ſuch as have three back-fins, as the cod-fiſh, the whiting, &c.; ſuch as have two back-fins, as the ling, the tunny-fiſh, the mackerel, &c.; ſuch as have but one back-fin, and inhabit the ſea, as the herring, the pilchards, &c.; and ſuch as have but one back-fin, inhabit rivers, and want teeth, as the carp, the bream, &c.

5. Fiſhes having ſome rays in the back-fins furniſhed with ſharp prickles: Theſe are ſubdivided into ſuch as have two back-fins, the anterior of which has prickly rays, as the pearch, the flying fiſh, &c.; and ſuch as have one back-fin, with the anterior rays prickly and the poſterior ones ſoft, as the ſea-pearch, the ſtickleback, &c.

Mr Willoughby's deſcriptions are ſcrupulouſly accurate and minute. Beſides, where any difficulties occur in diſtinguiſhing one ſpecies from another, he generally ſubjoins a few ſhort marks, the more eaſily to aſcertain their differences. The hiſtorical part is conducted with great candour and modeſty, no facts being admitted but ſuch as either conſiſted with the author's knowledge, or were ſufficiently atteſted by men of learning and credit.

§ 13. Of RAY.

It is an unfortunate circumſtance, that men whoſe inclinations lead them to the cultivation of ſcience are ſo ſeldom endowed with thoſe nicer feelings which are neceſſary to the formation of taſte. A few individuals, impelled by conſtitutional inclination, by accident,

or

or by neceſſity, apply the whole force of their minds to particular ſubjects. By this means new facts, and ſometimes new principles, are diſcovered. But theſe are too often uſhered into the world in ſuch a cold and forbidding manner, that, inſtead of attracting general attention, they are only peruſed by men of ſimilar tempers, who are equally ill qualified to recommend them. Natural hiſtory, a ſcience replete with variety, regularity, utility, and every ſpecies of beauty which can gratify the human intellect, laboured long under the oppreſſion of phlegmatic writers. During this period, the oeconomy of nature was almoſt entirely overlooked. Even thoſe who diſcovered a fondneſs for natural knowledge, inſtead of meeting with applauſe, were often deſpiſed and ridiculed: And, indeed, while naturaliſts continued to be only mere collectors of gnats and butterflies, they perhaps deſerved no better treatment.

In order to propagate a taſte for any ſcience, no other requiſite is neceſſary than a good writer to repreſent it in proper colours. Natural hiſtory, towards the end of laſt century, was powerfully recommended to the attention of mankind by the labours of our illuſtrious countryman, the Reverend Mr John Ray; a man ſo remarkable for ſolidity of learning and correctneſs of taſte, that, from peruſing his valuable works, it is difficult to diſcover which of theſe reſpectable qualities ſhone moſt conſpicuouſly in his character. Before this worthy author's time, although, as we have ſeen, ſeveral laudable attempts were made to reduce the ſubjects of natural hiſtory to a kind of methodical arrangement, none of their authors ſeem to have had ſuch comprehenſive views of nature as to enable them to form a ſyſtem founded upon ſolid principles. But as the character of Mr Ray and of his writings are ſo univerſally known and admired, it would be ſuperfluous to ſay any more on that ſubject.

We therefore proceed to give a ſhort view of the author's methodical diſtribution of animals.

Mr Ray, in the year 1693, publiſhed his Synopſis of Quadrupeds and Serpents. His Hiſtory of Inſects was publiſhed in the year 1710, by order of the Royal Society; and his Synopſis of Birds and Fiſhes in the 1713, under the inſpection of Mr Derham; both theſe laſt were printed ſeveral years after the author's death.

In the ſynopſis of quadrupeds, Mr Ray lays down a general diviſion of the animal kingdom, which he comprehends under two great claſſes, viz. 1. The ſanguineous. 2. The exangueous.

The ſanguineous are ſubdivided into thoſe which reſpire by lungs, and whoſe hearts are furniſhed with two ventricles; and thoſe which reſpire by gills, as all the ſanguineous fiſhes, except the cetaceous tribe. But ſome animals have two lungs, as the cetaceous fiſhes, viviparous quadrupeds, and birds; and others only one, as the oviparous quadrupeds and ſerpents. Animals with two lungs are either viviparous or oviparous. The viviparous are ſubdivided into aquatic, as the cetaceous fiſhes; and terreſtrial, as the quadrupeds covered with hair. The oviparous animals with two lungs comprehend the whole claſs of birds.

The exangueous are divided into the larger, which are either ſoft, as the cuttle-fiſh, &c. Cruſtaceous, as the lobſter, &c. or teſtaceous, which again are either furniſhed with one valve, two valves, or one turbinated; and the leſſer, which include inſects properly ſo called.

QUADRUPEDS.

QUADRUPEDS.

Mr Ray divides viviparous quadrupeds into two orders, viz. I. Such as are hoofed. II. Such as have nails or claws.

The firſt order is ſubdivided into, 1. Whole-hoofed, as the horſe, aſs, and zebra. 2. Cloven-hoofed, which either ruminate, as the ſheep-kind, &c. or do not ruminate, as the hog kind. The ruminating animals are again diſtinguiſhed into two kinds, viz. Such as do not caſt their horns, as ſheep, goats, &c. and ſuch as do caſt their horns, as the deer-kind. 3. Four-hoofed, as the rhinoceros, hippopotamus, &c.

The ſecond order, comprehending animals with nails or claws, are diſtinguiſhed, by the number of toes and nails or diviſions in their feet, into bifid, or thoſe furniſhed only with two toes or nails, as the camel-kind; and multifid, or ſuch as have more than two: The laſt are ſubdivided into ſuch as have undivided toes, or toes adhering to one another, and covered with a common ſkin, their extremities only ſtanding out, and fortified with obtuſe nails, as the elephant; and ſuch as have divided toes: Quadrupeds with divided toes have either broad nails like thoſe of men, as the ape-kind, or narrower claws, with cutting teeth in each jaw: Theſe are again diſtinguiſhed into ſuch as have many cutting teeth; and ſuch as have only two. Thoſe with many cutting teeth are all carnivorous and rapacious, or at leaſt feed upon inſects, or promiſcuouſly on inſects and vegetables, and are divided into the greater kind, furniſhed with a ſnout, which is either roundiſh, as in the cat-kind, or longer, as in the dog-kind; and the leſſer kind, with long ſlender bodies and

ſhort

ſhort legs, as the weaſel, otter, &c. Thoſe with two cutting teeth, are all herbivorous, as the hare-kind.—The hedge-hog, armadillo, mole, ſhrew-mouſe, ant-eater, bat, and ſloth are added here as anomalous.

The oviparous quadrupeds reſpire by lungs, and have but one ventricle in their hearts. Under this diviſion are comprehended frogs, tortoiſes, lizards, and ſerpents. The ſerpents are diſtinguiſhed into thoſe which have long, crooked, ſharp, exerted teeth, by which they bite and infuſe a venom into the wound, as the viper, the rattleſnake, &c.; and thoſe which have no ſuch teeth, and are not venomous, as the common ſnake, &c.

Birds and Fishes.

In theſe two claſſes, the diviſions and principles of arrangement are ſo nearly the ſame with thoſe of Mr Willoughby, that it would be ſuperfluous to repeat them.

Insects.

Mr Ray, from the transformation of many inſects, comprehends the whole under the two following diviſions: I. Inſects which undergo no change from their original ſtate. II. Inſects which ſuffer a transformation.

The firſt diviſion is diſtinguiſhed into thoſe which have no feet; and thoſe which have feet. Inſects without feet are again either terreſtrial or aquatic. The land-inſects either live in the ground, as the earth-worms, or in the inteſtines of men and other animals, as the

the teretes, tænia, and aſcarides. The aquatic inſects are divided into the greater, as leeches, &c.; and the leſſer, as the ſmall worms called flukes, &c. Inſects with feet are diſtinguiſhed into ſuch as have 6 feet; ſuch as have 8 feet; ſuch as have 14 feet, as the wood-lice, &c.; and ſuch as have many feet. The 6-footed inſects are divided into terreſtrial and aquatic. The terreſtrial are either larger, as meal-worms, &c.; or leſſer, as the bug, the common louſe, &c. The 8-footed inſects are either furniſhed with a tail, as the ſcorpion, or have no tail, as ſpiders, mites, &c. The many-footed inſects are likewiſe divided into terreſtrial, and cylindrical, as the julus; terreſtrial plain or compreſſed, as the ſcolopendræ; and aquatic, as the lugs or ſea-bait, &c.

In the ſecond diviſion, comprehending inſects which ſuffer a transformation, Mr Ray follows Swammerdam's method, who diſtinguiſhes them by the circumſtances attending their different changes. The firſt ſpecies of transformation is performed ſo ſuddenly, that hardly any time intervenes between the two different ſtates or forms of the animals, as in the dragon-flies, graſshoppers, crickets, &c. The ſecond ſpecies of transformation comprehends thoſe inſects which undergo a double metamorphoſis, being firſt changed to a chryſalis, remaining for ſome time without motion and without taking any nouriſhment, and then to a fly. Theſe are diſtinguiſhed, by their wings, into coleoptera, or thoſe which have cruſtaceous ſheaths covering their wings, as the beetles; and anelytra, or thoſe which have no ſuch covering to their wings; which laſt are ſubdivided into ſuch as have farinaceous wings, as the butterflies; ſuch as have four membranaceous wings, as bees, &c.; and ſuch as have two membranaceous wings, as the fleſh-fly, &c.

The

The third ſpecies of transformation is ſimply from a caterpillar to a fly, the caterpillar lying quiet for ſome time before its change, and comprehends ſeveral kinds of muſcæ.

N. B. This hiſtory and diſtribution of inſects was left in a crude ſtate, and never finiſhed for the preſs by the author.

The different ſynopſes of animals written by Mr Ray are not to be conſidered as mere technical diſtributions. His arrangements indeed are founded on good principles; and his deſcriptions are ſhort, but clear and comprehenſive. However, beſides arrangement and deſcription, the author, particularly in his ſynopſis of quadrupeds, frequently ſubjoins a conciſe hiſtory of manners and diſpoſitions. In the arrangement and deſcriptions, extenſive erudition and a ſound underſtanding, joined to a habit of accurate obſervation, are eminently conſpicuous. In the hiſtory of individuals, Mr Ray diſcovers an elegancy of taſte, a ſcrupulous regard to truth, a manly philoſophical firmneſs, and, above all, a warm attachment to virtue and the genuine happineſs of mankind.

§ 14. Of ARTEDI.

Petrus Artedi, a native of Sweden, and fellow ſtudent of Linnæus, with whom he lived in habits of the moſt intimate friendſhip, died at an early period of life, having fallen into a canal near Amſterdam, where he unfortunately periſhed in the 30th year of his age. Natural hiſtory was the ſubject in which he chiefly delighted; but he applied himſelf particularly to ichthyology, a branch of that ſcience which had been leaſt cultivated. After examining with the minuteſt

minuteſt attention all the fiſhes produced in his own country, Artedi travelled into Holland, Britain, &c. with a view to improve himſelf ſtill farther in his favourite ſtudy. Not ſatisfied with the arrangement of Willoughby and Ray, he compoſed a ſyſtem founded upon different principles. After the death of Artedi, Linnæus procured his manuſcripts, and publiſhed his method and deſcription of fiſhes at Leyden in the year 1738.

Artedi diſtributes fiſhes into thoſe which have perpendicular tails, with rays in their fins; and thoſe which have horizontal tails. Thoſe with perpendicular tails are divided into bony fiſhes; and cartilaginous fiſhes. The bony fiſhes conſtitute three orders: 1. Malacopterygii, or fiſhes with ſmall bones in their gills, and ſoft rays in their fins, as the carp, the bream, the herring, &c. 2. Acanthopterygii, or fiſhes with ſmall bones in their gills, and pungent or prickly rays in their fins, as the mullet, the mackerel, the ſtickleback, &c. 3. Branchioſtegi, or fiſhes which have no bones in their gills, as the ſun-fiſh, the frog-fiſh, &c. There is but one order of the cartilaginous fiſhes, viz. the chondropterygii, or fiſhes the rays of whoſe fins are hardly diſtinguiſhable from the membrane; they have cartilages in place of bones, and their mouths are generally ſituated in the under part of their bodies, as the lamprey, the balance-fiſh, the ſkate, the ſhark, &c. The fiſhes with horizontal tails likewiſe conſtitute but one order, viz. the plagiuri, which comprehends the whale-kind.

The deſcriptions of Artedi are fuller and more ſcientific than thoſe of moſt ichthyologiſts. He has likewiſe added a multitude of ſynonimes.

§ 15. Of KLEIN.

Mr Klein, an ingenious methodiſt, publiſhed a new arrangement of fiſhes in the year 1740. Since that time, he has favoured the world with a methodical diſtribution of quadrupeds, birds, teſtaceous animals, and reptiles, &c.

Quadrupeds.

Theſe Mr Klein divides into the three following orders. I. Hoofed quadrupeds. II. Toed and hairy quadrupeds. III. Toed quadrupeds without hair.

The firſt order he ſubdivides into five families. 1. Quadrupeds with one hoof, as the horſe and aſs. 2. With double or cloven hoofs, as the ox-kind, the ſheep-kind, &c 3. With three hoofs, as the rhinoceros. 4. With four hoofs, as the hippopotamus. 5. With five hoofs, as the elephant.

The ſecond order comprehends viviparous quadrupeds furniſhed with toes, and covered more or leſs with hair. Theſe are likewiſe ſubdivided into five families. 1. Quadrupeds with two toes, as the camel and ſilenus. 2. With three toes, at leaſt uniformly in the fore-feet, as the ſloth and ant-eater. 3. With four, uniformly in the fore-feet, as the armadillo, &c. 4. With five toes, uniformly in the fore-feet, as the hare, the ſquirrel, &c. 5. With anomalous feet, as the otter, caſtor, walrus, phoca, and manati.

The third order comprehends, 1. Quadrupeds covered with a ſhell,

ſhell, as the tortoiſes. 2. Quadrupeds covered with a hard cataphractous ſubſtance, as the crocodile. 3. Naked quadrupeds, as lizards, frogs, &c.

Birds.

Mr Klein divides birds into eight families. His principle of arrangement is ſolely derived from the number, ſituation, and ſtructure of the toes.

Order I. Birds with two toes, both placed forward, as in the oſtrich.

II. — With three unconnected toes, all placed forward, as the caſſiowary, the buſtard, the green plover, &c.

III. — With four toes, two before and two behind, as the parrots, woodpecker, cuckoo, &c.

IV. — With four toes, three before and one behind, as the eagle, vulture, hawk, owl, crow, pie, bird of paradiſe, lark, nightingale; the wren, the ſwallow, the linnet, the woodcock, the humming birds, the curlew, the gallinaceous tribe, the columbine tribe, the crane, &c.—A ſtrange, unnatural combination!

V. — With four toes, three before, connected by a membrane, the back-toe looſe, as ſwans, geeſe, gulls, divers, &c.

VI. — With four toes, all connected by a membrane, as the ſolengooſe, cormorant, &c.

VII. — With three toes placed forward, all connected by a membrane, as the guillemot, penguin, albatroſs, &c.

VIII. — With four toes, having lobes, or looſe membranes, adhering to the three fore-toes, and the back one generally without any lobe, as the creſted loon, the coot, &c.

Fishes.

Theſe are divided into three orders. The firſt comprehends ſuch as reſpire by lungs, as the cetaceous tribe. The ſecond order contains thoſe fiſhes which reſpire by occult gills, or gills which do not appear externally: Fiſhes of this kind are furniſhed with ſpiracles or ſmall holes, in ſome placed behind, in others laterally, and in others, in the thorax. The ſubdiviſions of this order are regulated by the number of theſe ſpiracles. The third order includes ſuch fiſhes as have viſible gills. Any thing remarkable in the head, mouth, and form of the body is employed for the ſubdiviſions of this order.

Testacea, or Shell Animals.

Mr Klein makes two general diviſions of ſhell-animals, the firſt of which he calls cochlides, and the ſecond conchæ. The cochlides have teſtaceous ſpiral canals, ſmall and cloſe at one end, the ſpires gradually enlarging in a uniform propo tion, *till they terminate in* the mouth of the ſhell. The conchæ are concave ſcouped ſhells, ſuch as limpets, muſcles, &c.

The cochlides are divided into ſimple and compound. The ſimple cochlides are ſpiral canals formed by a ſingle revolution of the ſhell,

ſhell, and are diſtributed into eight claſſes, viz. 1. Plain, as the nautilus, cornu ammonis, &c. 2. Convex, as the nerita, luna, &c. 3. Vaulted, as the pentadactylus, &c. 4. Elliptical, as the ear-ſhell, &c. 5. Conical, as the ſtrombus, &c. 6. Cochlea, or ſimple cochlides ſimilar to obtuſe and ſomewhat inclined cones, as the fornax, ſaccus, &c. 7. Buccinum, as the whelks and trumpet-ſhells. 8. Turbo, wreath or whirl ſhells.—The compound cochlides are ſuch ſhells as have a double circumvolution, ſo that they appear to be compoſed of two. Theſe are divided into five claſſes. 1. Roſtrata, or beaked ſhells, as the gladius, &c. 2. Shells with a long volute, as the turricula, &c 3. Shells with an oval volute, as the bulla, cithara, &c. 4 Alata, or winged ſhells, as the harpago, &c. 5. Murex, caltrop or rock-ſhells, as the triangular whelk, &c.

The conchæ are divided into ſix claſſes. 1. Monoconcha, or ſingle-valved ſhells, as the limpets. 2. Diconcha, or two-valved ſhells, are ſubdivided into equal and connivext, as oyſters, muſcles, &c.; equal and interrupted, as the chama, &c.; and inequal, as the terebratula, &c. 3. Polyconcha, or ſhells with more valves than two, as the anatifera or barnacle. 4. Nidüli teſtacei, acorn-ſhells, or collections of ſhells in the form of little roundiſh neſts, either ſolitary or adhering to other ſea-bodies, as the balanus, &c. 5. Echini marini, or ſea-urchins. 6. Tubuli marini, or ſea-tubes.

Reptiles.

Theſe are divided into two orders. I. Anguis, comprehending the ſerpent tribe. II. Worms.

The firſt order is ſubdivided into, 1. Serpents with diſtinct heads and

and tapering tails: Theſe are again diſtinguiſhed into ſuch as have canine teeth, as the vipers; ſuch as have pectinated teeth, like the pike-fiſh, as the ammodites, &c.; ſuch as have teeth reſembling needles, as the coluber dipſas, aeſculapius, &c.; and ſuch as have no teeth, as the ſerpens ceraſtes of Seba, &c. 2. Serpents with undiſtinct heads, and truncated tails, as the amphiſbæna and ſcytale.

The ſecond order, viz. worms, are all included under three genera; 1. Lumbricus, comprehending earth-worms, water-worms, and ſuch as inhabit the bodies of animals. 2. Tænia, or the tape-worm. 3. Hirudo, or leech.

Mr Klein's method is ingenious; but his principles of arrangement are ſo limited, that very incongruous animals are often linked together.

§ 16. Of LINNAEUS.

This learned and indefatigable naturaliſt appeared in the character of a ſyſtematic writer as early as the year 1735. After that period, he gradually improved and enriched his *Syſtema Naturæ* till the laſt edition of that valuable work, which he publiſhed at Holme in the year 1766-7. Since his death, however, Profeſſor Gmelin of Goettingen, with much induſtry and knowledge, publiſhed an improved edition, being the 13th, at Leipſic, in the year 1788. As twenty years had elapſed ſince the 12th edition was preſented to the public by the celebrated Linnæus, many diſcoveries in the animal kingdom had been made, in different quarters of the globe, by laborious and ingenious travellers. Theſe Profeſſor Gmelin has not only collected and deſcribed, but has incorporared them into

into his edition of the Syſtema Naturae of Linnaeus, by which, without materially altering the plan and arrangement, he has highly enriched and enhanced the value and utility of the work.

Linnaeus diſtributes the animal kingdom into ſix Claſſes: I. Mammalia, or animals that ſuckle their young, which includes man, the quadrupeds, and the whale-kind. II. Birds III. Amphibious animals. IV. Fiſhes. V. Inſects. VI. Worms.

Class I. Mammalia.

I. The mammalia are divided into ſeven orders. The orders of the mammali are chiefly regulated by the number and ſituation of the teeth. 1. *Primates*, or animals with one canine and four cutting teeth. This order includes man, and all the ape, monkey, and bat-kinds, 2. *Bruta*, or animals which have no cutting teeth in either jaw, as the elephant, ant-eater, &c. 3. *Ferae*, or animals whoſe cutting teeth vary from ten to two. This order comprehends moſt of the rapacious quadrupeds, as the dog, cat, and bear kinds, &c. 4. *Glires*, or animals which have only two cutting, and no dog-teeth, as the mouſe, ſquirrel, hare, &c. 5. *Pecora*, or animals which are hoofed, and have no cutting teeth in the upper jaw. This order includes the camel, the deer, the ſheep, and the ox-kinds, &c. 6. *Belluae*, or quadrupeds with cutting teeth in each jaw; as the horſe, the ſow, &c. 7. *Cetae*, or animals, whoſe teeth vary greatly in different genera. This order comprehends all the cetaceous, or whale tribes, which Linnaeus, from certain ſimilarities of ſtructure, has arranged under the claſs of quadrupeds.

Class

Class II. Birds.

This claſs Linnaeus divides into ſix orders. The diſtinctive characters of the orders are chiefly derived from the bills and the feet. I. *Accipitres*, (eagle or hawk kind) birds with hooked bills, and ſhort, robuſt limbs. Under this order are comprehended vultures, falcons, owls, &c. They build their neſts in rocks, and elevated ſituations. II. *Picae*, (pies) or birds with bills ſhaped like a knife and convex on the backs. The limbs are fitted for walking, being ſhort and pretty ſtrong. They build their neſts in trees. III. *Anſeres* (ducks) have ſmooth bills, covered with a ſkin, and expanded at their termination. Their toes are connected by a membrane, which enables them to ſwim. They generally build their neſts on the ground. IV. *Grallae*, or birds with obtuſe and nearly cylindrical bills. The limbs are fitted for walking, and the thighs are partly deſtitute of feathers. They generally build their neſts on the ground. To this order belong cranes, ſnipes, &c. V. *Gallinae*, or birds with convex bills. The toes are divided, but ſtrongly connected above by articulations, and fitted for walking or running. This order comprehends the pheaſant, grous, peacock, &c. kinds. VI. *Paſſeres*, or birds with conical ſharp-pointed bills. To this order belong the pigeon, the ſwallow, the thruſh, &c. kinds.

Class III. Amphibious Animals.

This claſs comprehends all thoſe animals which, from certain peculiarities in the ſtructure of their lungs, are enabled to live either in air or in water. Linnaeus divides this claſs into two orders. I.

Reptilia

Reptilia pedata, or reptiles furniſhed with feet, including turtles, lizards, frogs, &c. II. *Serpentes apodes*, or reptiles without feet. This order comprehends all the ſerpent and ſnake kinds.

Class IV. Fishes.

In the claſs of fiſhes, which Linnaeus divides into ſix orders, the principal marks of diſtinction are derived from peculiar circumſtances attending the gills and fins. The firſt four orders comprehend all thoſe fiſhes which have oſſeous gills; and this fact muſt be underſtood as applicable to the other characters the author employs to diſtinguiſh theſe orders.

Order I. *Apodes*, or fiſhes which have no ventral, or belly fins. This order comprehends all the eel tribes, whether they inhabit ſeas, lakes, or rivers. 2. *Jugulares*, or fiſhes with the ventral placed before the pectoral fins, as in the haddock, whiting, ling, &c. kinds. 3. *Thoracici*, or fiſhes with the ventral ſituated near the pectoral fins, as in the feather-laſher, holibut, plaiſe, &c. 4. *Abdominales*, or fiſhes with the ventral ſituated behind the pectoral fins, as the pike, the mullet, the herring, &c. 5. *Branchi ſtegi*, or fiſhes whoſe gills are deſtitute of oſſeous matter, as the ſun-fiſh, pike-fiſh, frog fiſh, &c. 6. *Chondropterygii*, or fiſhes with cartilaginous gills, as the ſturgeon, dog-fiſh, balance-fiſh, &c.

Class V. Insects.

Under this claſs Linnaeus comprehends all animals which are

provided with *antennae*, or feelers, ſituated in the fore-part of their heads. The orders of inſects, which are ſeven in number, are chiefly derived from their wings. They are diſtinguiſhed into thoſe which have four, thoſe which have two, and thoſe which are deſtitute of wings. To the firſt order Linnaeus gives the appellation of *coleoptera*, or four winged inſects whoſe upper pair conſiſt of a cruſtaceous or horny ſubſtance, and join in a future or ridge. Theſe cover and defend the under pair, which are of a ſoft and flexible texture. This order includes the whole *ſcarabaei* or beetle tribe. 2. *Hemiptera*, inſects which have likewiſe four wings; but the upper pair, inſtead of being hard and horny, have a reſemblance to fine vellum, as in *graſshoppers*, *locuſts*, *crickets*, &c. 3. *Lepidoptera*, or inſects whoſe wings are covered with imbricated ſcales. This order comprehends all the *butterfly* and *moth* tribes. 4. *Neuroptera*, or inſects with four membranaceous wings, ſo interſperſed with delicate veins, that they reſemble beautiful net-work, as the *dragon-fly*, the *ſpring-fly*, &c. 5. *Hymenoptera*, or inſects with four membranaceous and naked wings, as the *waſp*, the *bee*, &c. In ſome of the genera, however, arranged under this order, the neuters, and, in others, the males, or even the females, have no wings. Their tails, except in the male ſex, are armed with a ſting. 6. *Diptera*, or two winged inſects. Beſide wings, the ſpecies of this order are furniſhed with what is called a *halter*, or a *poiſer*, which is ſituated under each wing, and terminates in a *capitulum*, or knob. Under this diviſion are comprehended the *gad-fly*, the *gnat*, &c. 7. *Aptera*, or inſects which are deſtitute of wings, as the *louſe*, the *flea*, the *ſcorpion*, &c. VI. *Vermes*, or *worms*. This order includes not only all the inſects commonly called *worms*, but all the teſtaceous animals, and the zoophytes, or plant-animals.

§ 17.

§ 17. Of BUFFON.

I. Of Quadrupeds.

The firſt volume of the *Hiſtoire Naturelle, generale et particuliere, avec la Deſcription du Cabinet du Roi*, was publiſhed at Paris in the year 1749. The hiſtorical part is the compoſition of M. de Buffon; the deſcriptive and anatomical parts are written by M. Daubenton. To avoid, however, the frequent repetition of two names, we ſhall uſe that of Buffon only.

We found not much difficulty in giving ſhort views of the writings of thoſe naturaliſts who preceded the celebrated author now before us. If we may judge of the character of a man from his literary performances, M. de Buffon, when tried by this teſt, appears in ſuch a variety of agreeable and brilliant aſpects, that, unleſs he be ſurveyed with uncommon coolneſs and attention, the imagination of the reader will be hurried away by an almoſt irreſiſtible torrent of eloquence. Conſcious of the ſtrength of his own genius, he diſdains the fetters and dull formalities of methodical diſtribution, which men of leſs fancy, but perhaps of ſuperior judgement, have uniformly regarded as an eſſential article in the communication of ſcience. To give ſome idea of our author's fertility and copiouſneſs, it ſhall only be mentioned, that his hiſtory of quadrupeds alone conſiſts of 15 large volumes in 4to. But when the multiplicity of ſubjects which he embraces are attended to; when we find him employing a whole volume on the method of ſtudying natural hiſtory, and on the theory of the earth; another in order to ſupport a peculiar theory of ge-

neration; a third in deſcribing the articles contained in the cabinet of the king, and the various races of men; a long diſcourſe on the nature of animals, another reprobating methodical arrangements; and, above all, when it is conſidered that the author was a moſt eloquent and ingenious Frenchman, we have reaſon to be ſurpriſed that he ſhould have begun the hiſtory of his firſt quadruped ſo early as in the middle of the fourth volume.

The deſign of the preſent chapter obliges us to confine our obſervations chiefly to that part of M. de Buffon's work which contains the principles upon which he thinks natural hiſtory ought to be taught and ſtudied.

M. de Buffon aſſerts *, that all methodical diſtributions are purely arbitrary; and, therefore, that every man is at liberty to chuſe that which is moſt convenient, or moſt generally received. Let us ſuppoſe a man, he remarks, totally void of ideas, and conſequently unbiaſſed by prejudices of every kind. Place this man in a country ſtored with quadrupeds, birds, fiſhes, and plants. At firſt he will not be able to diſtinguiſh one object from another; but, allow his ideas to be gradually unfolded by reiterated impreſſions from the ſame objects, and he will ſoon be in a capacity to diſtinguiſh animated from inanimated matter; in a ſhort time afterward, he will likewiſe perceive the difference between animal and vegetable ſubſtances, and thus naturally arrive at the firſt great diviſion of natural bodies into Animal, Vegetable, and Mineral. As by this time he will have acquired diſtinct ideas of thoſe grand objects, Earth, Air, and Water, he will ſoon form a particular notion of ſuch animals as inhabit theſe different elements, and, of courſe, will eaſily make a ſecond

* Hiſt. Nat. tom. 1. p. 31. et ſeq. 4to. a Paris, 1749-1772.

cond diviſion of animals into quadrupeds, birds, fiſhes, &c. Let us next ſuppoſe, continues our author, that this man has acquired an equal portion of knowledge and experience with ourſelves, and he will form a judgment of the objects of natural hiſtory ſolely by the relations which they reſpectively have to himſelf. Thoſe which are moſt neceſſary or uſeful to him will occupy the firſt rank; for example, in arranging quadrupeds, he will give the preference to the horſe, the dog, the ox, &c. Thoſe which inhabit the ſame country, as the ſtag, the hare, and, in general, all the wild or undomeſticated animals, will be the next in order: Laſtly, his curioſity will prompt him to inquire into the nature of ſuch animals as inhabit foreign climates, and will proceed in the ſame manner with regard to birds, fiſhes, inſects, teſtaceous animals, plants, minerals, and every other production of nature. This our ingenious author ſuppoſes to be the moſt natural order, and, accordingly, obſerves it in his hiſtory of animals. We ſhall mention his arrangement of quadrupeds in a more ſimple form from the 168th page of the 4th volume—I. Domeſtic quadrupeds. II. Wild quadrupeds. III. Foreign quadrupeds.

We ſhould be apt to imagine that M. de Buffon, when he laid down this principle of arranging animals, had not only been miſtaken in his philoſophy, but had forgotten the ſubject upon which he was writing: That young and uninformed minds gradually acquire additions to their ſtock of ideas from the objects which ſurround them and ſolicit their attention, or, in other words, that objects, in proportion to the novelty of their appearance, and the utility they promiſe to afford us, make the deepeſt impreſſions on our minds, and, of courſe, their properties are not only firſt attended to, but more minutely inveſtigated than thoſe which are either more

diſtant

diſtant or leſs intereſting, is a fact that cannot admit of a doubt. But the obſervation, however juſt, is here miſapplied. If we did not know that M. de Buffon was endeavouring to aſcertain the principles of arranging the animal world, we ſhould be led to think that he was tracing the manner in which ideas were acquired, and the proportional force of the impreſſions we receive from external objects. But, who would not be aſtoniſhed to ſee this fact applied to a ſcience of an oppoſite nature, and conſtructed upon very different principles? There are many other relations by which mankind are connected to the animate and inanimate productions of Nature than what ariſe from utility and local ſituation. Beſides, the principle is extremely limited and defective. The connection of mankind with natural objects is, in many caſes, entirely caſual, depending on the climate, the ſtate of the ſociety in which he lives, with regard to culture, inſtitutions, prejudices, and a thouſand fortuitous circumſtances. Again, are there no natural relations between the various tribes of brute animals? Are they all related to man, without any connection among themſelves? Have they no common properties in the form of their bodies, their movements, or in the internal powers by which their actions are governed? M. de Buffon will not go ſo far; and yet he makes very near approaches. 'An aſs,' ſays he, 'is an aſs, and a cat, a cat *.' 'Nature,' he remarks, in another place †, 'proceeds from one ſpecies to another by ſuch imperceptible degrees, that we are often tempted to link many of them together as belonging to the ſame family. We ought not, however, 'to forget, that theſe families, or genera, are created by ourſelves, 'in order to aſſiſt the underſtanding; and that, if we cannot comprehend the real connections of natural objects, it is our own fault, 'and

* L'Hiſt Nat. vol. I. p. 7.

† Ibid. vol. 4. p. 384. et ſeq.

'and no defect in Nature, who knows nothing of thoſe pretended 'families, and who, in fact, has only made individuals. An indi- 'vidual is a detached being, which has nothing in common with 'other beings, except that it reſembles, or rather differs from them. 'All the ſimilar individuals which exiſt upon this earth are conſi- 'dered as compoſing the ſpecies of theſe individuals. It is not, 'however, the collective number of individuals, but their conſtant 'ſucceſſion and renovation, which conſtitute their ſpecies.'

In this and many other paſſages, M. de Buffon endeavours to perſuade us, that no ſuch thing as genus exiſts in Nature, but that all her productions are unconnected ſpecies, or mere collections of ſucceſſive individuals. He allows, indeed, that the connections or differences of many ſpecies are often ſo imperceptible, that we are in danger of concluding them to be of the ſame family. This admiſſion is ſufficient. It relinquiſhes the very point for which he ſo ſtrenuouſly contends; a circumſtance by no means uncommon in the works of this moſt ingenious, but verſatile author. If Nature has made the connections of different ſpecies ſo ſtrong that it requires conſiderable attention to diſcover their differences, it cannot be ſuppoſed that ſhe had no deſign in this plan of operation. Her benevolent intentions, on the contrary, are numerous. The intimate connections and nice diſtinctions of natural objects give riſe to an immenſe variety of beings, which could not poſſibly exiſt, if the gradations were larger and the diſtinctions more apparent. They aſſiſt the mind in forming general and comprehenſive views of the univerſe. They are the foundation upon which every art and ſcience is conſtructed, as, without their aſſiſtance, no man could form an abſtract or general idea; it is needleſs to ſay more. We ſhould, indeed, have conſidered it ſuperfluous to have reaſoned

with

with a philoſopher who denies the exiſtence of genus in the univerſe, had his knowledge and taſte been as capricious as his ſcientific principles.

For what purpoſe, then, it may be aſked, has M. de Buffon given himſelf the trouble of writing, and his readers the labour of peruſing ſo much argumentation upon a ſubject ſo obvious? To ridicule all preceding and cotemporary writers who have obſerved method in their works, and perſuade mankind that Nature prefers confuſion to order! M. de Buffon, however, is ſo very unſtable, that he ſeldom long preſerves his poiſe. In the paſſage formerly quoted, he denies the exiſtence of genera. But we muſt ſuppoſe him to have entirely overlooked what he had ſaid in the 140th page of the ſame volume. Let us attend to his ſentiments at that time. 'We have already,' ſays he, 'many connected facts and obſervations with regard to the 'different ſpecies of animals, which are employed as diſtinguiſhing 'characters in the various methodical diſtributions. In theſe me-'thods we find an uniform deſcription of the ſame parts in each dif-'ferent animal. This is ſo conformable to our plan, that we ſhall 'have recourſe to thoſe deſcriptions in treating of ſuch foreign ani-'mals as we have never ſeen. There is ſtill another advantage to 'be derived from thoſe methods: They ſupply us with general 'concluſions from a great number of particular obſervations. The 'reſemblance of particular parts in different ſpecies of animals forms '*generic characters*. The reſemblances which take place between 'animals belonging to different *genera* form ſtill more extenſive cha-'racters, by which orders and claſſes are determined. Thus, the 'characters of the genera, orders, and claſſes, are ſo many general 'conſequences derived from particular obſervations, and, of courſe, 'are neceſſary facts in the hiſtory of animals.'

It

It may be farther remarked, that M. de Buffon's method of claſſing animals is founded entirely upon a confined and local idea. Domeſtic, wild, and foreign animals, with a few exceptions, vary according to the climate and ſtate of the country in which a man lives. The rein-deer is a domeſtic animal in Lapland, and the ichneumon is a domeſtic in Egypt; but both are foreign animals in France. The guinea-pig is naturally a foreigner in Europe; but it is now a domeſtic in France and in ſeveral other European countries. Many examples might be added to ſhew the abſurdity of this method of arranging natural hiſtory; but, as one grand and uniform example, and which, indeed, includes all other examples, we ſhall refer the reader to the *Hiſtoire Naturelle et particuliere* of M. de Buffon, where he will find animals ſucceſſively deſcribed in the greateſt confuſion which the moſt capricious fancy can imagine. But, to give ſome idea of the confuſion reſulting from this order, the ingenious Mr Pennant ſeriouſly tells us, in the Preface to his excellent Synopſis of Quadrupeds, that the book was originally deſigned for private amuſement, and as an index for the more eaſily finding any particular animal deſcribed in the voluminous hiſtory of quadrupeds by the celebrated M. de Buffon.

But it is time to take a more agreeable view of this great and admirable writer. His hiſtory of animals is compoſed in ſuch a lively, entertaining, and inſtructive manner, that it muſt be highly reliſhed by every reader of taſte. His facts are numerous, his anecdotes are pleaſant, his characters are ſtrongly marked. Some people think his writings diffuſe; but it is univerſally agreed, that this diffuſion is ſo natural, and ſo bewitching, that the diſcovery is never made till the reader has peruſed the whole ſubject of which the author is treating.

How eaſily do mankind deceive themſelves, and how naturally does this deceit lead them into contradiction and abſurdity? M. de Buffon, in the 26th page of his firſt volume, juſtly reprehends Aldrovandus for intolerable prolixity; and tells us, that his hiſtory might be reduced to one-ſixth of its preſent ſize, if the immenſe load of uſeleſs and foreign matters were removed. But, the ingenious Frenchman had not the moſt diſtant idea, when he made this pertinent remark, that he was writing a ſevere ſatire on his own book, which had, by that time, ſwelled to eighteen large volumes in quarto, beſides his hiſtory of birds, which conſiſts of nine volumes more; and, if he had fortunately lived to complete his plan, the work would have been a much more ponderous load than that of the voluminous German.

We ſhall diſmiſs this learned and laborious compoſition, with a few obſervations on the deſcriptive part; for which we are indebted to the ſkill and indefatigable induſtry of M. Daubenton. The deſcriptions are generally taken from the life, and with ſuch aſtoniſhing minuteneſs, that it is not without reluctance we are obliged to think a great part of this labour uſeleſs. Our author's plan of deſcribing is ſo extenſive, that every minute part of the body, whether external or internal, is not only fully deſcribed, but its length, breadth, and thickneſs, are accurately meaſured. He takes an individual of a ſpecies, and, after a general deſcription, he proceeds to a menſuration of the particular parts, as the length of the head; the contour of the mouth; the diſtance between the angles of the under jaw; the diſtance between the noſtrils; the length of the eye from one angle to the other; the diſtance between the two pupils; the diſtance between the ears, &c. He is equally minute in the dimenſions

menſions of the different bones of the ſkeleton, and of the heart, lungs, ſtomach, and other inteſtines.

The general dimenſions are neceſſary; as, without theſe, a diſtinct idea of the animal could not be conveyed. But exact meaſurements of every minute part of which the different members of the body are compoſed, render the deſcription not only tedious and perplexed, but ſwell the book to an enormous ſize. Beſides, the dimenſions will not correſpond with thoſe of any other individual of the ſame ſpecies. Deſcribe and meaſure a man, or any other animal, in this manner, and you may travel from the one pole to the other without finding another individual to whom theſe dimenſions will exactly apply.

II. Of Birds.

Every admirer of the production of nature muſt congratulate himſelf that the life of the great, the ingenious, and the laborious M. de Buffon was continued till he had been enabled to complete his Natural Hiſtory of Quadrupeds, as well as that of the feathered tribes.

In this laſt department of Natural Hiſtory, he had a thouſand difficulties to encounter; particularly in deſcribing and diſtinguiſhing the ſmaller ſpecies of birds, who not unfrequently intermix, and produce numerous fertile varieties. For this reaſon, in his plan of the work, he remarks that, inſtead of deſcribing birds by diſtinct and ſeparate ſpecies, he has united ſeveral of them under the ſame ſpecies. By this method, he has conſiderably abridged the Natural Hiſtory of Birds; which, upon a more extenſive ſcale, would have been too voluminous

voluminous and uninteresting. He, therefore, confines his descriptions to domestic birds, and to the larger or more remarkable species. All the other birds, and particularly the smaller kinds, he unites with their kindred species, and groupes them together, as being nearly of the same natural dispositions, and as belonging to the same family. The number of relations, as well as that of varieties, is always greater in proportion to the smallness of the species. A sparrow or a linnet have, perhaps, twenty times more parents than those of the ostrich or the turkey. By the number of parents is to be understood the number of neighbouring species, which have such resemblances to each other as to make them be regarded as collateral branches of the same stem.—These neighbouring species have probably been separated from each other by the influence of climate, of food, and of the succession of time, which brings along with it all possible combinations, and unfolds all the causes of variegation, of perfection, of change, and of degeneration. Independently of natural and accidental varieties, which are much more numerous among birds than quadrupeds, another cause concurs in augmenting apparently the number of species. Birds, in general, are more libidinous and more prolific than quadrupeds. They unite more frequently; and, when they cannot find females of their own species, they intermix more freely than quadrupeds with neighbouring species, and commonly produce fertile mules. This fact is established by the spontaneous commixture of the goldfinch and canary bird; for the mongrels they produce by their union are prolific, and, of course, form new intermediate species, which have more or less resemblance to the parents from whom they derive their origin. Now, whatever we procure by art may be, and actually is, performed by Nature. Fortuitous and voluntary commixtures often happen among animals of different species, and particularly among birds, who frequently, when

when their natural mates cannot be obtained, uſe the firſt bird, ſimilar in magnitude, that preſents itſelf. The neceſſity of union is ſo preſſing, that moſt birds, in this ſituation, are ſick, and not unfrequently die, when prevented from gratification. In court-yards, we often ſee a cock, when ſeparated from hens, lay hold of another cock, of a capon, of a guinea-hen, or of a duck. The pheaſant, in the ſame ſituation, makes uſe of a common hen. In volaries, the canary and goldfinch, the red and the common linnet, unite with ardor; and who knows what amours take place in the deep receſſes of the woods? who can recount the number of illegitimate embraces among different ſpecies? who can divide the baſtard branches from the genuine ſtems *?

Having given an account of M. de Buffon's Natural Hiſtory of Birds, nearly in his own words, it is almoſt ſuperfluous to remark, that, in this branch of the ſcience, he uniformly preſerves the character he had formerly acquired. His deſcriptions are accurate and clearly expreſſed; his hiſtorical narrations are not only elegant and entertaining, but diſcover great learning, candour, and deep reſearch.

§ 18. Of BRISSON.

M. Brisson, in the year 1756, publiſhed at Paris a Synopſis of Quadrupeds and Cetaceous Animals; and a new arrangement of Birds in 1760.

Quadrupeds.

* Buffon, Hiſt. Nat. des Oiſeaux, tom. 1. Plan de l'ouvrage, p. 20.

QUADRUPEDS.

Theſe M. Briſſon diſtributes into eighteen Orders.

Ord. I. Comprehends ſuch quadrupeds as have no teeth in either jaw; as the ant-eater and ſcaly lizard.

II. Quadrupeds furniſhed with grinders only, as the ſloth and armadillo.

III. ——With grinders and dog-teeth only, as the elephant, moiſe, and manati.

IV. ——With ſix cutting teeth in the under jaw only, as the camel.

V. ——With eight cutting teeth in the under jaw, as the giraffe, the goat-kind, the ſheep-kind, &c.

VI. ——With cutting teeth in each jaw, and whole-hoofed, as the horſe and aſs.

VII. ——With cutting teeth in each jaw, and cloven-hoofed, as the hog-kind.

VIII. ——With cutting teeth in each jaw, and three-hoofed, as the rhinoceros.

IX. ——With two cutting teeth in each jaw, as the river-hog.

X. ——With ten cutting teeth in each jaw, as the tapiir, or elephant-hog.

XI. ——With cutting teeth in each jaw, and four-hooſed, as the hippopotamus.

XII. ——With toes and claws, and two cutting teeth in each jaw, as the porcupine, caſtor, hare, ſquirrel, mouſe, &c.

XIII. ——With toes and claws, and four cutting teeth in each jaw, as the ape-kind, &c.

XIV. — With toes and claws, four cutting teeth in the upper, and ſix in the under jaw, as the bats, &c.

XV.

XV. ——With toes and claws, ſix cutting teeth in the upper, and four in the under jaw, as the ſeal.

XVI. ——With toes and claws, and ſix cutting teeth in each jaw, as the hyæna, the dog-kind, weſels, badgers, bears, and cats.

XVII. ——With toes and claws, ſix cutting teeth in the upper, and eight in the under jaw, as the mole.

XVIII. ——With toes and claws, ten cutting teeth in the upper, and eight in the under jaw, as the opoſſum-kind.

Cetaceous Animals.

After the example of Linnæus, M. Briſſon places the whale-tribe next to the quadrupeds, and divides them into four orders.

Ord. I. Without teeth, as the Greenland whale, North-caper, the bunch-back whale, &c.

II. With teeth in the under jaw only, as the catodon or potwal-fiſh, the ſpermaceti-whale, &c.

III. With teeth in the upper jaw only, as the monoceros.

IV. With teeth in each jaw, as the dolphin, the porpeſſe, the grampus, &c.

Birds.

M. Brisson divides birds into twenty ſix Orders.

Ord. I. Birds with four unconnected toes, three forward, one backward, having their legs covered with feathers nearly down to the talons, a ſtrait bill, the upper mandible a little thicker, and crooked toward the point, and the noſtrils half covered with a thick ſoft membrane, as in the pigeon-tribe.

II. The ſame characters, with a conical bill bent inward, as in the gallinaceous tribe.

III. ——With a ſhort hooked bill, comprehending eagles, hawks, &c.

IV. ——With a long conical bill, as in pies, &c.

V. ——With a ſtrait bill, and the edges of each ſide of the upper mandible emarginated, as in the butcher's bird, &c.

VI. ——With a ſtrait bill, and both mandibles entire, as in the beef-eater, &c.

VII. ——With a ſlender bill, a little bent arch-ways, as in the hoopoe, &c.

VIII. ——With a very ſmall bill, compreſſed at the baſe, crooked at the point, and the mouth, when open, larger than the head, as in the goat-ſucker, &c.

IX. ——With a ſhort conical bill, as in the ſparrow, &c.

X. ——With a bill ſhaped like an awl, as the lark, &c.

XI. ——With a bill ſhaped like a wedge, as the ſitta, &c.

XII. ——With a bill long and ſlender like a thread, as the honey-ſucker, certhia, &c.

XIII. Birds with four unconnected toes, two forward, two backward, as parrots, &c.

XIV. Birds with four toes without membranes, three forward, one backward, the middle toe firmly adhering to the outmoſt as far as the third joint, as the manakin, bee-eater, &c.

XV. Birds with unconnected toes, the inferior part of the limbs naked, the wings ſmall in proportion to the ſize of the body, and unfit for flying, as the oſtrich, caſſowary, &c.

XVI. Birds with three unconnected toes, all forward, the inferior part of the limbs naked, and the wings large and proper for flying, as the plover, &c.

XVII.

XVII. Birds with four unconnected toes, three forward, one backward, the inferior part of the limbs naked, and the wings fit for flying, as the jacanu, woodcock, heron, &c.

XVIII. Birds with four unconnected toes, three forward, one backward, all furnished with membranes through their whole extent, as the coot, gallinule, &c.

XIX. Birds with four toes, the three anterior of which are connected by a membrane extending about one half of their length, the posterior toe loose, and the legs placed far back, and nearly concealed by the abdomen, as the grebe, &c.

XX. Birds with three toes forward, wholly connected by a membrane, and no back-toe, with the legs situated as in Order 19. as the guillemot, penguin, &c.

XXI. Birds with four toes, the three anterior ones entirely connected by a membrane, and the back one loose, with the legs situated as in Order 19. as the diver, &c.

XXII. Birds with three toes forward entirely connected by membrane, and no back-toe; the legs placed near the middle of the body, and shorter than the body, as the albatross, &c.

XXIII. Birds with four toes, the three anterior entirely connected by a membrane, and the back one loose; the legs placed near the middle of the body, and shorter than the body: and the bill having no teeth, as the petrel, gulls, &c.

XXIV. The same character with the former, only the bill is dentated, as the merganser, duck, &c.

XXV. Birds with four toes, all entirely connected by a membrane, the limbs placed near the middle, and shorter than the body, as the cormorant, pelican, &c.

XXVI. Birds with four toes, the anterior three joined by a mem-

brane, and the poſterior one looſe; the legs placed near the middle, and longer than the body, as the flamingo, avocette, &c.

M. Briſſon diſcovers himſelf to be an able naturaliſt. His deſcriptions are clear, conciſe, and pointed. His principles of arrangement are ingenious, but too confined to anſwer the purpoſes of a general ſyſtem of Nature.

§ 19. Of PENNANT.

For more than twenty years paſt, this gentleman has been occaſionally enriching the ſcience of Natural Hiſtory by uncommon induſtry, knowledge, and ingenuity. Beſides his other valuable works, he has favoured the world with new arrangements of quadrupeds, birds, reptiles, fiſhes, and ſhell-animals.

In claſſing quadrupeds, Mr Pennant, as he candidly acknowledges, makes Mr Ray, that celebrated naturaliſt, his principal guide; but, from more recent diſcoveries, and other circumſtances, he has been enabled to improve Mr Ray's arrangement.

Class I. Quadrupeds.

Mr Pennant divides quadrupeds into four orders. I. Hooſed quadrupeds, as the horſe, ox, ſheep, deer, &c. II. Digitated, or toed, quadrupeds, including apes, monkies, dogs, cats, &c. III. Pinnated or finned, as the walrus, ſeals, &c. IV. Winged quadrupeds,

drupeds, as all the bats, twenty one ſpecies of which are known and deſcribed.

Class II. Birds.

This numerous claſs of animals Mr Pennant comprehends under two great diviſions, viz. I. Land birds. II. Water birds. Theſe two he ſubdivides into nine orders: Diviſion I. Land birds. Order 1. Rapacious birds, as the vultures, falcons, owls, &c. 2. Pies, as the parrot, cuckoo, crow, kingſiſher, &c. 3. Gallinaceous, as the turkey, peacock, partridge, &c. 4. Columbine, including all the ſpecies or varieties of pigeons. 5. Paſſerine, comprehending all the ſmall birds, from the ſize of a thruſh to that of the golden-creſted wren, of which the lark, the wagtail, the ſwallow, &c. are examples. 6. Struthious. This order includes the dodo, the oſtrich, and caſſowary, the moſt limited of all the ſubdiviſions of the feathered tribes. Diviſion II. Order 7. Cloven-footed, or waders, as the heron, ſnipe, plover, &c. 8. Birds with pinnated feet, as the coot, grebe, &c. 9. Web footed, as the duck, gull, pelican, &c.

Class III. Reptiles.

Mr Pennant defines this claſs in the following terms: 'Body 'covered either with a ſhell or ſtrong hide, divided by futures; four 'fin-like feet; and a ſhort tail.' Under this claſs are comprehended the tortoiſe, the frog, the lizard, the viper, and the ſnake kinds.

Class IV. Fishes.

These animals Mr Pennant ſeparates into three orders, or diviſions. I. Cetaceous fiſhes, comprehending all the whale-tribe. II. Cartilaginous fiſhes, or fiſhes whoſe muſcles are ſupported by cartilages, inſtead of bones. The lamprey, ſkate, ſhark, &c. are examples. III. Bonny fiſhes, whoſe muſcles are ſupported by bones or ſpines. In the ſubdiviſions of this order, Mr Pennant follows Sir Charles Linnæus. 1. Apodal, or fiſhes which are deſtitute of ventral fins, as the eel, wolf-fiſh, ſword-fiſh, &c. 2. Jugular, or fiſhes which have the ventral fins placed before the pectoral, as in the haddock, cod-fiſh, &c. 3. Thoracic, or fiſhes with the ventral fins ſituated beneath the pectoral, as in the flounder, perch, mackerel, &c. 4. Abdominal, or fiſhes whoſe ventral fins are placed behind the pectoral, as in the ſalmon, pike, herring, carp, &c.

Class V. Crustaceous Animals.

Under this claſs Mr Pennant comprehends the numerous tribes of crabs, lobſters, &c.

Class VI. Worms.

These are divided into, I. The inteſtine; II. The ſoft; III. The teſtaceous. Under diviſion I. Mr Pennant comprehends the hair worm, the aſcarides, and ſuch worms as infeſt the inteſtines of men and

and other animals, leeches, &c. II. Molluſca, or ſoft-worms, as the ſlug, the aphrodita, the cuttle-fiſh, &c. III. Teſtaceous, or animals furniſhed with ſhells. Theſe are ſubdivided into, *a*. Multivalved ſhells, as the barnacle, &c. *b* Bivalved ſhells, as the muſcles, razor-ſhell, oyſter, cockle, ſcallops, &c. *c*. Turbinated ſhells, or thoſe which have ſpiral turns, as the turbo, or wreath, the periwinkle, the terebra or auger, garden ſnail, &c. *d*. Univalve ſhells not turbinated, as the common limpet, &c.

I AM not without apprehenſion that this Chapter, to ſome readers, may appear to be dry and unintereſting. I ſhall only remark, that it has coſt me much labour, as muſt be evident from the numerous and voluminous works which I have been obliged to peruſe and analyſe. This much I muſt be allowed to ſay, that, when I began the ſtudy of Natural Hiſtory, ſuch an analytical account of the writings on that ſubject, from Ariſtotle to the preſent time, would not only have been highly grateful, but would have ſaved me more time and ſtudy than I can deſcribe. If it ſhall be ſo fortunate as to facilitate the labours, or rather prevent young men from the neceſſity of undergoing the ſame labour, I ſhall be happy in the reflection, that I have at leaſt endeavoured to be uſeful to thoſe explorers of the wonderful works of that inſcrutable BEING who planned and executed what Man, who arrogantly ſtyles himſelf the LORD of CREATION, can never be able fully to unfold. Reflections of this kind, however, ſhould rather ſtimulate than depreſs the ſpirit of human inquiry.

CHAP.

CHAPTER II.

Of the Multiplication and Continuation of Species.

IN treating of this moſt intricate and delicate ſubject, I ſhall endeavour to avoid every idea that might lead to wantonneſs, or impropriety. No philoſophical inquiry into the wonderful operations of Nature, if expreſſed in irreproachable terms, can merit reprehenſion.

SECT. I.

Of the diviſion of Animals into viviparous and oviparous—Some Animals belong to neither of theſe diviſions.

THE idea of dividing animals into *Viviparous* and *Oviparous* muſt have been as antient as the exiſtence of human beings. But the diſcovery, that many of the ſmaller animals were endowed with the faculty of multiplying without the intervention of either of theſe modes of procreation was reſerved to a very modern age. This diſcovery was made partly by natural obſervation, but more extenſively by the aid of the microſcope. In the firſt volume of this work, I have given many examples of ſingular modes by which Nature has enabled particular animals to multiply their ſpecies *. It would, therefore, be ſuperfluous here to ſay more upon that ſubject.

SECT.

* Vol. I. p. 30. et ſeq.

SECT. II.

An account of the principal Theories, both antient and modern, which have been publiſhed on this ſubject; particularly with regard to the larger Animals.

THE doctrine of equivocal generation, or the production of animated beings by a fortuitous commixture of inert and corrupted materials, though firmly believed by the antients, has of late been ſo completely refuted by Redi; and other unprejudiſed inveſtigators of the genuine operations of Nature, that it deſerves no farther notice.

§ I.—HIPPOCRATES, who lived above five hundred years before Ariſtotle, taught an opinion upon this ſubject, which was adopted by Galen, and by moſt phyſicians for many ages. Hippocrates maintained the exiſtence of a female fluid, and even that both the male and the female had two fluids, the one ſtrong and active, the other weaker and leſs active *. A concurrence of the two ſtronger fluids, he remarks, produces a male, and of the two weaker, a female. This abſurd notion he endeavours to ſupport by obſerving, that ſeveral women, who produced girls only by their firſt huſband, have had boys by their ſecond; and that the ſame thing has often happened to men who have had two wives. Hippocrates next tells us, that

* Hippocrat. lib. de Genitura, p. 129. et lib. de Diæta, p. 198. Lugd. Bat. tom. 1. 1665.

that the ſemen proceeds from every part of the body, and particularly from the head; becauſe, he remarks, thoſe who have had the veins behind their ears cut, ſecrete only a weak and often an unfertile ſemen. The female likewiſe ſheds a ſeminal fluid ſometimes within and ſometimes without the uterus. The ſemen of the male enters the uterus, and intermixes with that of the female; and, as each poſſeſſes two kinds of fluid, the one ſtrong and the other weak, if both of them furniſh the ſtrong kind, a male foetus is the conſequence; and, if both furniſh the weak kind only, the reſult is a female: Beſides, if in the mixture there are more particles of the male than of the female fluid, the child will reſemble the father more than the mother; *et e contra.*

We ſhall now exhibit a ſhort account of Hippocrates's notion of the mode by which the foetus is formed. The ſeminal fluids, ſays he, firſt mix in the uterus, and gradually thicken by the heat of the mother. The mixture extracts the ſpirit of heat, and, when too warm, part of the heat eſcapes into the air. But a cold ſpirit is likewiſe conveyed to it by the reſpiration of the mother. Thus a cold and a hot ſpirit alternately enter the mixture, give life to it, and cover its ſurface with a pellicle, which aſſumes a round figure, becauſe the ſpirits, by acting in the center, expand the matter equally on all ſides. I have ſeen, this great philoſopher remarks, a foetus of ſix days old: It was a ball of liquor incloſed in a pellicle. The liquor was reddiſh; and the pellicle was interſperſed with red and colourleſs veſſels. In the middle of the liquor there was a ſmall eminence, which I imagined conſiſted of the umbilical veſſels, by which the foetus receives nouriſhment and the ſpirit of reſpiration from the mother. A ſecond covering or pellicle gradually forms above the firſt. Plenty of nouriſhment is furniſhed by the menſtrual blood, which coagulates

lates and is converted into fleſh. This fleſh gradually articulates, and derives its form from the ſpirit. Every part aſſumes its proper ſtation; the ſolid parts unite; the moiſt particles aſſociate by themſelves; every thing ſearches for what is analogous to it; and, in fine, the foetus, by the operation of theſe cauſes, is completely formed.

§ 2.—The next theory we ſhall mention is that of the celebrated ARISTOTLE. After enumerating ſome varieties in the ſtructure and modes of multiplying exhibited to our obſervation by different ſpecies of animals, he examines the opinion of the more antient philoſophers, who maintained that the ſemen of both male and female was extracted from every part of the body. Ariſtotle diſſents from this opinion; becauſe, ſays he, though children often reſemble both father and mother, they ſometimes alſo reſemble their grandfathers. Beſides, they reſemble their parents in the voice, in the hair, in the nails, and in the gait and manner of walking. Now, proceeds our author, it is impoſſible for the ſemen to come from the hair, from the voice, from the nails, or from any external quality, as that of the mode of walking. Hence children reſemble not their parents becauſe the ſemen proceeds from all parts of the body. The ſeminal liquor of the male, Ariſtotle remarks, is ſecreted from the blood; and the menſtrual fluid of the female is likewiſe a ſecretion from the blood, and the only matter that contributes to generation. Females, he continues, have no other prolific fluid; no mixture, therefore, of male and female fluids take place. This he attempts to prove by obſerving, that ſome women conceive without any titillation; that few emit any fluid in coition; that, in general, thoſe who are brown, with a maſculine air, have no emiſſion, and yet their powers of pro-

creation are not leſs than thoſe of a fairer complexion and more delicate appearance, who emit copiouſly. Thus, he concludes, women furniſh nothing for the purpoſes of generation, but the menſtrual blood. This blood is the matter of generation, and the male fluid contributes the form only. The male fluid is the efficient cauſe, and the chief principle of motion; it is to generation what the ſculptor is to a block of marble: The ſeminal fluid is the ſculptor, the menſtrual blood the marble, and the fœtus the figure. The male ſemen gives to the menſtrual blood both life and motion, or a kind of ſoul. This ſoul is neither material nor immaterial, becauſe it can neither act upon matter, nor augment the menſtrual blood, which is the only matter neceſſary to generation. It is a ſpirit, ſays our philoſopher, ſimilar to that of the element of the ſtars. The heart is the firſt production of this ſoul; which is the cauſe of its own growth, and of the growth and diſpoſition of all the other members. The menſtrual blood contains the *capacities* of all the parts of the fœtus; the ſoul or ſpirit of the male ſemen makes the heart begin to *act*, and communicates to it the powers of beſtowing action on the other viſcera; and, in this manner, the different parts of the animal are ſucceſſively unfolded.

Theſe two great men have had each their followers. Moſt of the ſcholaſtic philoſophers adopted Ariſtotle's theory of generation; but the ancient phyſicians, in general, adhered to the theory of Hippocrates. In this manner near eighteen centuries paſſed without the veſtige of any thing new concerning this myſterious ſubject. Upon the revival of literature, however, anatomiſts began to make reſearches into the nature of generation.

§ 3.—FABRICIUS AB AQUAPENDENTE firſt made a courſe of experiments

experiments upon the impregnation and expanſion of the eggs of fowls, the ſubſtance of which ſhall be laid before the reader. Fabricius diſtinguiſhes the matrix of a hen into two parts, the one ſuperior, the other inferior. The ſuperior part, which he calls the *ovarium*, contains an aſſemblage of a great number of ſmall yellow eggs, of a round figure, the ſizes of which vary from that of a muſtard ſeed to that of a walnut. Theſe eggs are attached to one another by foot-ſtalks, and the whole group has a reſemblance to a bunch of grapes.

After impregnation, an egg is detached from the common pedicle, and gradually deſcends, through a winding canal, into the inferior part of the matrix. The canal is filled with a liquor ſimilar to the white of an egg. In this canal the egg receives its white liquor, the membrane in which it is incloſed, the two cords *(chalazae)* that run through the white, and join it to the yolk, and the ſhell, which is ſuddenly formed before excluſion. Theſe cords, ſays Fabricius, are the part of the egg which is impregnated by the ſeminal ſpirit of the male; and it is here alſo that the rudiments of the fœtus firſt make their appearance. The egg is not only the true matrix, or the place where the fœtus is formed, but upon it the whole proceſs of generation depends. The egg is the great agent in generation; it furniſhes both the matter and the organs. The ſubſtance of the cords is the matter of which the chick is formed; the white and the yolk ſupply it with nouriſhment; and the ſeminal ſpirit of the male is the efficient cauſe. This ſpirit communicates to the cords, firſt, an alterant quality, then a forming quality, and, laſtly, a power of augmenting, &c.

§ 4.—HARVEY, our celebrated countryman, who, at ſo late a

period, it is almoſt incredible to think, firſt diſcovered the circulation of the blood, has likewiſe given us an ingenious treatiſe on generation. He flouriſhed about the middle of laſt century, and was phyſician to Charles I. He alledges, that men, and all other animals, proceed from eggs; that, in viviparous animals, the firſt produce of conception is a kind of egg; and that the only difference between the viviparous and oviparous is, that, in the former, the fœtus begins to exiſt, increaſe, and arrive at its full growth while it remains in the uterus; but that, in oviparous animals, the fœtus begins to exiſt, when in the form of an egg, in the body of the mother, and it is only after excluſion and incubation, that it becomes a living animal. It farther deſerves to be remarked, ſays he, that, in oviparous animals, ſome retain their eggs till they be perfect, as birds, ſerpents, and oviparous quadrupeds; and that others exclude their eggs before they have arrived at maturity, as fiſhes, cruſtaceous, and teſtaceous animals. The eggs laid by theſe creatures are only the rudiments of eggs, which afterwards acquire membranes and a white, and attract nouriſhment from the matter with which they are ſurrounded. He adds, that there are inſects, caterpillars, for example, which are only imperfect eggs; they ſearch for and take nouriſhment, and, at the end of certain times, they arrive at the chryſalis ſtate, which is a perfect egg. Another difference is remarkable in oviparous animals: The eggs of hens, and of other birds, are of different ſizes, but thoſe of fiſhes, frogs, &c. who lay them before they are perfect, are all of the ſame ſize. He indeed obſerves, that, in pigeons, who lay two eggs, all the ſmall eggs, which remain in the ovarium, are of the ſame bulk; and that the two only which are next to be excluded exceed the ſize of the reſt. The ſame phænomenon takes place in cartilaginous fiſhes, as in the ray, which brings to maturity only two eggs at a time.

Harvey

Harvey next deſcribes anatomically the parts neceſſary to generation; and he remarks, that the ſituation of the anus and vulva in birds differs from that of all other animals, the anus being placed before, and the vulva behind. Hens produce eggs without the intervention of the cock; but, though ſeemingly perfect, they are fewer in number, and totally unfertile. He credits not the common opinion, that a few days intercourſe with the cock are ſufficient to impregnate all the eggs which a hen ſhall lay during a whole year; but he acknowledges, that he ſeparated a hen from the cock for twenty days, and that all the eggs ſhe laid were fecundated.

The two cords *(chalazæ)* which Fabricius ab Aquapendente conſidered to be the germ, or part produced by the male ſemen, are found in unimpregnated, as well as impregnated eggs; and Harvey juſtly remarks, that theſe parts neither proceed from the male, nor receive the impregnation. The part of the egg which receives the impregnation is a ſmall white circle ſituated upon the membrane that covers the yolk, and has the appearance of a cicatrice about the ſize of a lentil. Harvey likewiſe remarks, that this cicatrice is found in all eggs, whether they be fecundated or not; and that thoſe are deceived who imagine it to be produced by the ſemen of the male. It is of the ſame ſize and form in freſh eggs as in thoſe which have been long kept. But, as ſoon as the proceſs of hatching is begun, whether by artificial heat or by that of the hen, this ſmall mark or cicatrice gradually augments and dilates like the pupil of the eye. This is the firſt change, and it is viſible after a few hours of incubation. When the egg has been heated 24 hours, the yolk, which was formerly in the centre, riſes towards the cavity at the thick end of the egg. This cavity is occaſioned by the evaporation of the more fluid part of the white, the heavier part of which falls down to the

ſmall.

ſmall end. The cicatrice or ſpeck on the membrane of the yolk is elevated along with it, and applies itſelf to the membrane which lines the cavity at the thick end. This ſpeck is now as large as a pea; and a white point is diſtinguiſhable in the middle of it, with ſeveral circles, of which that point appears to be the common centre.

At the end of the ſecond day, theſe circles are larger and more conſpicuous; and they divide ſometimes into two, and ſometimes into three parts, which are of different colours. A ſmall external protuberance likewiſe appears, nearly reſembling a little eye, with a white point or cataract on the pupil. Between the circles is contained a tranſparent liquor by means of a very thin membrane. The ſpeck, which is now become a ſmall liquid globe, appears as if it were ſituated in the white, rather than on the membrane of the yolk. On the third day, the tranſparent liquor, as well as the membrane in which it is incloſed, is conſiderably augmented. On the fourth day, a ſmall line of blood, of a purple colour, appears on the circumference of the liquid globe; and, at a little diſtance from the centre, we perceive a dot or point, of a bloody colour, which has pulſations like a heart. It is viſible at every diaſtole, and diſappears during the ſyſtole. Two ſmall blood-veſſels iſſue from this animated point, and terminate in the membrane which contains the tranſparent liquor. Theſe blood-veſſels ſet off from the ſame place nearly in the ſame manner as the roots of a tree ſet off from the trunk. It is in the angle which theſe roots form with the trunk, and in the middle of the liquor, that the animated point is ſituated.

About the end of the fourth, or beginning of the fifth day, the animated point is ſo much enlarged, that it has the appearance of a ſmall bladder filled with blood; and by its contractions and dilatations

tions, it is alternately filled and emptied. On the ſame day, we perceive diſtinctly, that this bladder is divided into two parts, each of which dilates and contracts in the ſame manner. Round the ſhorteſt of the blood-veſſels mentioned above, a kind of cloud appears, which, though almoſt tranſparent, obſcures the view of the veſſel. This cloud becomes every hour thicker; it attaches itſelf to the root of the blood-veſſel, and ſeems to depend from it like a ſmall globe. This globe ſtretches out, and appears to divide into three parts, one of which is globular, and larger than the other two; and here we perceive the rudiments of two eyes, and of the whole head. At the end of the fifth day, in the remainder of this lengthened globe, the commencement of the vertebrae. On the ſixth day, the parts of the head are more apparent. We can diſtinguiſh the coats of the eyes, the thighs, and the wings; and then the liver, the lungs, and the beak. The foetus now begins to move and to ſtretch out its head, though, of the inferior parts, nothing but the viſcera are yet formed; for the thorax, the abdomen, and all the external coverings of the fore part of the body, are ſtill wanting. At the end of this day, or the beginning of the ſeventh, the claws begin to be viſible; the chick opens and moves its beak; and the anterior parts of the body begin to cover the viſcera. On the ſeventh day, the chick is entirely formed; and, from this time till it iſſues from the egg, nothing remarkable happens but a gradual expanſion of all the parts it had acquired during the firſt ſeven days. The feathers appear on the 14th or 15th day; and, on the 21ſt, the chick eſcapes from the egg, by breaking the ſhell with its bill.

Beſide theſe experiments upon eggs, Harvey made many others upon female deer. They receive the male about the middle of September.

tember. A few days afterwards, the *horns* * of the uterus appear to be thicker and more fleſhy than uſual. They are, at the ſame time, more flaccid; and, in each of their cavities, five carunculae, or ſoft warts, appear. About the 26th or 28th of September, the uterus is ſtill thicker; and the five carunculae are ſwelled nearly to the ſize and form of a nurſe's nipple. On opening them with a ſcalpel, they appeared to be filled with an infinite number of white points.

About the end of October, or the beginning of November, when the females were ſeparated from the males, the thickneſs of the *horns* began to diminiſh, and their internal ſurfaces were ſwelled, and ſeemed to be glued together. The carunculae ſtill remained; and the whole maſs reſembled the ſurface of the brain, being ſo ſoft that it could not be touched without derangement. Harvey farther informs us, that on the 13th or 14th of November, he perceived thin filaments, like thoſe of a ſpider's web, which traverſed the cavities of the *horns*, and even that of the uterus itſelf. Theſe filaments derived their origin from the ſuperior angle of the *horns*, and, by their number, formed a kind of membrane or empty ſac. A day or two afterwards, this ſac was filled with a white, aqueous, viſcid matter, which adhered to the uterus by a ſpecies of mucilage; and the adheſion was moſt apparent at the ſuperior part of the uterus, where the rudiments of the placenta began then to appear. In the third month, this ſac contained an embryo about an inch and a half in length, and likewiſe an internal ſac, called the *amnios*, incloſing a tranſparent cryſtalline liquor, in which the foetus ſwam. At firſt, the foetus was only an animated point, like that which appeared in the hen's egg.

Every

* Two fleſhy proceſſes, one of which iſſues from each ſide of the *fundus uteri*, in the from of little *horns*, and are remarkable in ſome quadrupeds.

Every thing now proceeded and terminated in the ſame manner as deſcribed with regard to the chick, with this difference only, that the eyes of the chick appeared much earlier than thoſe of the deer. About the 19th or 20th of November, the animated point was viſible. A day or two afterwards, the oblong body, which contained the rudiments of the foetus, made its appearance. In ſix or ſeven days more, the foetus was ſo completely formed, that all its members, and even its ſex, were diſtinguiſhable. But the heart and viſcera were ſtill bare; and it was not till a few days after, that they were covered with the abdomen and thorax. This, Harvey remarks, is the laſt work, and the ſlating of the edifice.

From his experiments upon hens and deer, Harvey infers, that all female animals have eggs; that, in theſe eggs, a ſeparation of a tranſparent cryſtalline liquor, contained in a ſac (*amnios*), takes place, and that another external ſac (*chorion*) incloſes the whole fluids of the egg; that, in the cryſtalline liquor, the firſt object which appears is an animated ſanguineous point; and, laſtly, that the original formation of viviparous animals is effected in the ſame manner with that of the oviparous. Harvey farther concludes, that generation is an operation of the uterus alone; for not a drop of the male ſemen ever enters that organ. The uterus, he aſſerts, conceives by a kind of contagion communicated to it by the ſemen of the male, in the ſame manner, nearly, as the load-ſtone communicates a magnetic virtue to iron. This male-contagion acts not only on the uterus, but on the whole body of the female, which is entirely fecundated, though the uterus alone poſſeſſes the faculty of conception, in the ſame manner as the brain has the ſole power of conceiving ideas. The ideas, or impreſſions, conceived by the brain, are ſimilar to the images of the objects tranſmitted to it by the ſenſes; and the foetus,

which may be conſidered as the idea of the uterus, is ſimilar to that by which it is produced. Hence the reaſon why children reſemble their fathers, &c.

§ 5.—ABOUT fifty years after the trials of Harvey, MALPIGHIUS* carefully examined the cicatrice, which is the moſt eſſential part of an egg: He found that it was large in impregnated eggs, and ſmall in thoſe which had received no impregnation. He likewiſe diſcovered, that, in eggs which had never been ſat upon, the white point mentioned by Harvey as the firſt part that aſſumes animation, is a ſmall purſe or bubble ſwimming in the liquor bounded by the firſt circle; and that the embryo is viſible in the centre of this purſe. The membrane of the purſe, which is tranſparent, allowed him to ſee diſtinctly the fœtus within it. Malpighius, from this firſt obſervation, concludes with propriety, that the foetus exiſts in the egg before incubation, and that the rudiments of the embryo are even then deeply rooted. After aſcertaining this important fact, Malpighius proceeded to examine the cicatrice of unimpregnated eggs, which is ſmaller than in thoſe which had received an impregnation. Near the centre of the cicatrice, inſtead of a bubble including the foetus, there is a globular mole or unorganized maſs, which, when opened, exhibits nothing like regularity or arrangement of parts: It has only ſome appendages filled with a viſcid but tranſparent liquor; and this unformed maſs is enveloped in ſeveral concentric circles.

After ſix hours incubation, however, the cicatrice is conſiderably enlarged; and, in its centre, a bubble or globule, formed by the amnios,

* Malpighii pullus in ovo.

nios, is eaſily diſtinguiſhed. This globule is filled with a fluid, in the middle of which the head and back-bone of the chick are viſible. Six hours afterwards, the parts are all enlarged, and, of courſe, more apparent. In ſix hours more, that is, eighteen hours from the commencement of incubation, the head is larger, and the ſpine is lengthened; and, at the end of twenty-four hours, the head has acquired a bended poſture, and the ſpine is of a whitiſh colour. The vertebrae are ranged on each ſide of the ſpine, like ſmall globules; and, about the ſame time, the wings begin to ſhoot, and the head, neck, and breaſt are lengthened. At the end of thirty hours, nothing new appears, except that all the parts are enlarged, and particularly the amnios. Around this membrane, we can perceive the umbilical veſſels, which are of a dark colour. In thirty eight hours, the head of the chick is very large, and three veſicles appear in it ſurrounded with membranes, which likewiſe include the ſpine of the back, through which, however, the vertebrae are ſtill viſible. At the end of forty hours, it was admirable to obſerve, continues our author, the chick living in the centre of the liquor contained in the amnios. The back-bone was increaſed, the head was bended, the veſicles of the brain were leſs bare, the rudiments of the eyes appeared, the heart beat, and the blood circulated.

At the end of the ſecond day, the foetus appeared ſwimming in the liquor of the amnios; the head, which appeared to be compoſed of veſicles, was bended; the back-bone and vertebrae were lengthened; the heart, which hung out of the breaſt, always beat three times ſucceſſively, becauſe the fluid it contains is puſhed from the auricle into the ventricles, from the ventricles into the arteries, and, laſtly, into the umbilical veſſels. In fourteen hours more, or ſixty-two hours from the beginning of incubation,

the chick, though ſtronger, remained ſtill with its head bended in the liquor of the amnios: Veins and arteries were perceived in the brain; and the rudiments of the eyes, and of the ſpinal marrow, appeared. At the end of three days, the body of the chick was crooked. Beſide the two eyes, five veſicles filled with liquor were ſeen in the head; the rudiments of the thighs and of the wings were diſcerned; the body began to aſſume fleſh; and the pupils of the eyes, and likewiſe the cryſtalline and vitreous humours, were diſtinguiſhable. At the termination of the fourth day, the veſicles of the brain were nearer each other; the proceſſes of the vertebrae were longer; the wings and the thighs had become ſtronger in proportion as they grew longer; the whole body was covered with a gelatinous fleſh; the umbilical veſſels had pierced through the abdomen; and the heart was incloſed by a thin tranſparent membrane. On the fifth, and at the end of the ſixth day, the veſicles of the brain began to be covered; the ſpinal marrow, which was now more ſolid, was divided into two parts, and advanced along the trunk; the thighs were longer, and the wings were unfolded; the abdomen was ſhut and tumified; the liver was diſtinctly viſible, and of a dark colour; the two ventricles of the heart beat; the body of the chick was covered with ſkin; and the points of the feathers began to appear. On the ſeventh day, the head was very large; the brain was covered with its membranes; the beak appeared between the two eyes; the wings, the thighs, and the legs, had acquired their perfect form; the heart ſeemed to be compoſed of two ventricles, like two contiguous globules, united at their ſuperior part with the auricles; and two ſucceſſive pulſes were remarked both in the ventricles and auricles, as if there had been two ſeparate hearts.

§ 6.

§ 6.—We ſhall now give a ſhort account of De Graaf's experiments upon rabbits. He diſſected a female rabbit half an hour after copulation. The horns of the uterus, he remarks, were uncommonly red. No change had taken place in the ovaria, nor in the eggs which they contained; and there was not a veſtige of ſemen in the vagina, in the uterus, or in the Fallopian tubes. Six hours after copulation, he diſſected another rabbit; and obſerved that the follicles, which, in his eſtimation, contain the eggs in the ovarium, were become red; but he found no ſemen either in the ovaria or any where elſe. Twenty hours after copulation, he diſſected a third rabbit; and remarked in one ovarium three, and in the other five follicles much altered; for, inſtead of being clear and limpid, they were opaque and reddiſh. In another, diſſected twenty-ſeven hours after copulation, the horns of the uterus, and the ſuperior canals which terminate in them, were ſtill more red, and their extremities embraced the ovarium on all ſides. In another, opened forty hours after copulation, he found in one ovarium ſeven, and in the other three follicles charged. Fifty-two hours after copulation, he examined another, and diſcovered *in one ovarium four charged follicles*, and one in the other. Having opened theſe follicles, he diſcovered in them a kind of glandular liquor, with a ſmall cavity in the middle, in which he could perceive no fluid. This circumſtance led him to ſuſpect that the tranſparent liquor, uſually contained in the follicles, might have been diſcharged by ſome rupture of the membranes. He ſearched in vain for this matter in the canals which terminate in the horns of the uterus, and in the horns themſelves. He remarked, however, that the membranes which line the horns of the uterus were much ſwelled. In another rabbit, diſſected three days after copulation, he obſerved, that the ſuperior extremity of the canal, which terminates in the horns of the uterus, ſtraitly embraced

braced each ſide of the ovarium; and, after ſeparating it from the ovarium, he perceived, in the right ovarium, three follicles ſomewhat larger and harder than uſual. After carefully ſearching the canals formerly mentioned, he tells us, that he diſcovered an egg in the right canal, and two more in the right horn of the uterus; but they exceeded not the ſize of muſtard ſeeds. Theſe little eggs had each two membranes, of which the internal one was filled with a limpid liquor. Upon examining the other ovarium, he found four charged follicles; three of them were whiter, and had ſome limpid fluid in their centres; but the fourth was of a darker colour, and contained no liquor, which made him ſuſpect that the egg had deſcended. He therefore ſearched the correſponding canal and horn of the uterus, and found an egg in the ſuperior extremity of the horn, which was exactly ſimilar to thoſe he had diſcovered in the right horn. He ſays, that the eggs, when ſeparated from the ovarium, are ten times ſmaller than before their ſeparation. The difference in ſize, he imagines, is owing to this circumſtance, that the eggs, while in the ovarium, contain another matter, namely, the glandulous liquor which he remarked in the follicles.

He opened another rabbit, four days after copulation, and he found in one ovarium four, and, in the other, three follicles void of eggs. In the horns of the uterus correſponding to the ovaria, he found four eggs in the one, and three in the other. Theſe eggs were larger than thoſe he had diſcovered three days after copulation. They were nearly as large as the lead uſed for ſhooting ſmall birds; and he remarked, that, in theſe eggs, the interior membrane was ſeparated from the exterior, and the whole appeared as if a ſecond egg was contained within the firſt. In another rabbit, diſſected five days after copulation, he found five empty follicles in the ovaria,

and

and the ſame number of eggs in the uterus, to which they firmly adhered. Theſe eggs were as large as the ſhot employed for killing hares, and the internal membrane was ſtill more apparent than in the laſt experiment. Six days after copulation, he opened another rabbit; and, in one of the ovaria, found ſix empty follicles, but five eggs only in the correſponding horn of the uterus, and they ſeemed to be all accumulated into one maſs: In the other ovarium, he ſaw four empty follicles, and found but one egg in the correſponding horn. Theſe eggs were of the ſize of the largeſt fowling ſhot. Our anatomiſt opened another rabbit ſeven days after copulation, and found in the ovaria ſome empty follicles, which were larger, harder, and more red than thoſe he had formerly obſerved. He perceived as many tranſparent tumors in different parts of the uterus. Having opened theſe tumors, he took out the eggs, which were as large as ſmall piſtol bullets. The internal membrane was now more diſtinct than formerly; and within this membrane he ſaw nothing but a very tranſparent liquor. In another rabbit, diſſected eight days after copulation, he found in the uterus the tumors or cells which contain the eggs; but they adhered ſo firmly to the uterus, that he could not detach them. Nine days after copulation, he found the cells containing the eggs greatly enlarged, and perceived in the middle of the liquor incloſed by the internal membrane a thin ſmall cloud. Ten days after copulation, he found, in another rabbit, that the ſmall cloud was thicker and darker, and formed an oblong body reſembling a little worm. Twelve days after copulation, he perceived diſtinctly the embryo, which was now ſo apparent, that he could diſtinguiſh its different members. He ſaw, in the region of the breaſt, two red and two white points, and, in the abdomen, a reddiſh mucilaginous ſubſtance. The head of the fœtus, fourteen days after copulation, was large and tranſparent; the eyes were prominent;

nent; the mouth was open; the ears began to appear; the backbone was whitiſh, and bended towards the ſternum. From each ſide of the ſpine, ſmall blood-veſſels aroſe, the ramifications of which extended along the back as far as the legs. The two red points were now conſiderably enlarged, and ſeemed to be the rudiments of the two ventricles of the heart. On each ſide of the red points he ſaw two white ones, which were the rudiments of the lungs. In the abdomen, he perceived the rudiments of the liver, which was reddiſh, and a ſmall body twiſted like a thread, which was the ſtomach and inteſtines. After this, till the 31ſt day, when the female rabbit brings forth, nothing was to be remarked but the gradual expanſion and growth of the parts which had already been formed.

De Graaf, from theſe experiments, concludes, that all viviparous animals have eggs; that theſe eggs are contained in the ovaria or teſticles; that they cannot be detached till they are fecundated by the male ſemen; becauſe, he remarks, the glandular liquor, by means of which the eggs are enabled to eſcape from their follicles, is not ſecreted till after impregnation. He alledges that thoſe who imagine they have ſeen pretty large eggs in three days have been deceived; becauſe, in his eſtimation, the eggs, though fecundated, remain longer in the ovarium, and, inſtead of augmenting, become ten times leſs than formerly, and never begin to grow till after their deſcent from the ovaria into the uterus.

This pretended diſcovery of eggs in the teſticles of females attracted the attention of many anatomiſts. In the teſticles of viviparous females, however, they found only ſmall bladders, which they did not heſitate to conſider as real eggs; and, therefore, they called the teſticles *ovaria*, and the veſicles *eggs*. They likewiſe aſſerted, that the

the ſize of theſe eggs differed in the ſame ovarium; that the largeſt in the ovaria of women did not exceed the bulk of a ſmall pea; that they are very minute in young girls; but that they increaſe with age and intercourſe with men; that not above 20 could be diſcovered in each ovarium, that theſe eggs are fecundated in the ovarium by the ſpiritous part of the male ſemen; that, after impregnation, they ſeparate, and fall into the uterus through the Fallopian tubes; that the fœtus is formed of the internal ſubſtance of the egg, and the placenta of its external part; that the glandulous matter, which does not exiſt in the ovarium till after a fruitful embrace, compreſſes the egg, and forces it to part from the ovarium, &c.

But, of all anatomiſts, Malpighius and Valiſnieri ſeem to have written with moſt judgment upon this intricate ſubject. Malpighius, after examining the teſticles of many cows and other female animals, aſſures us, that he found in all of them veſicles of different ſizes, whether the females were very young, or adults. Theſe veſicles are incloſed in a membrane, the inſide of which is interſperſed with blood-veſſels; and the veſicles are filled with a kind of lymph or liquor, which, like the white of an egg, coagulates and hardens when expoſed to the heat of a fire. In proceſs of time, a firm yellow body adheres to the teſticles. It is prominent, increaſes to the ſize of a cherry, and occupies the greateſt part of the ovarium. This body conſiſts of ſeveral angular lobes, the poſition of which is very irregular, and it is covered with a membrane interſperſed with nerves and blood-veſſels. When the yellow body exceeds not the ſize of a grain of millet, it is roundiſh, and its ſubſtance, when cut, has a warty appearance. When it has acquired nearly the ſize of a pea, it is ſhaped like a pear; and, in its centre, there is a ſmall cavity filled with liquor. In ſome of theſe yellow bodies, after they

have come to maturity, Malpighius aſſerts, that, in the yellow bodies, he ſaw, near the centre, a ſmall egg, about the ſize of a millet ſeed; and that, after they had diſcharged the eggs, theſe bodies became empty and flaccid. He ſuppoſed that Nature deſigned this yellow glandulous body for the preſervation of the egg, and for making it eſcape from the teſticles; and, perhaps, he remarks, it contributed to the formation of the egg; and, conſequently, he concludes, that the veſicles, which are at all times found in the ovarium, and always differ in ſize, are not the real eggs which receive the impregnation, but only ſerve to produce the yellow bodies in which the eggs are formed. Beſides, though theſe yellow bodies are not uniformly found in every ovarium; yet the rudiments of them are always apparent. Malpighius found the marks of them in new born heifers, in cows with calf, and in pregnant women; and, therefore, he concludes, that theſe yellow glandular bodies are not, as alledged by De Graaf, a reſult of impregnation. The yellow bodies, he remarks, produce unfecundated eggs, which fall out of the ovarium independent of any communication with the male, as well as thoſe which fall after impregnation. When impregnated eggs fall into the uterus, every thing proceeds in the manner which De Graaf has deſcribed.

§ 7.—We ſhall now give an abridged view of the remarks of Valisnieri, a diſciple of Malpighius. In the year 1692, he began his experiments upon the teſticles of the ſow, which differ from thoſe of cows, of mares, of ſheep, and of moſt other viviparous animals; for they reſemble a ſmall bunch of raiſins, the grains of which are round and prominent. Between theſe grains are ſmaller ones, not yet arrived at maturity. Theſe grains ſeem not to be covered

vered with any common membrane. They are, he remarks, analogous to the yellow bodies obſerved by Malpighius in cows; they are round, and of a reddiſh colour; their ſurface is interſperſed with blood-veſſels; and the whole grains form a maſs which is larger than the ovarium.

In every ſow, the glandular bodies are not of the ſame colour. In ſome, they are more red; in others more clear; and their ſizes vary from that of the ſmalleſt ſeed, to that of a raiſin. When opened, a triangular cavity appears; it is filled with a limpid liquor, which coagulates with heat, and becomes white, like that contained in the veſicles. Valiſnieri expected to find eggs in ſome of theſe cavities. But this expectation was diſappointed; for, though he carefully ſearched all the glandular bodies of a number of ſows, and other animals, he could never diſcover the egg, which Malpighius ſays he once or twice found. Under theſe glandular bodies, the veſicles of the ovarium appeared, which were more or leſs numerous according as the glandular bodies were larger or ſmaller; for, in proportion to the largeneſs of the glandular bodies, the veſicles diminiſhed. Some veſicles were of the ſize of a lentil, and others did not exceed that of a millet ſeed. In the teſticles, when raw, from twenty to thirty-five veſicles might be reckoned; but, when boiled, a much greater number appear; and they are ſo firmly attached, that they cannot be ſeparated without breaking ſome of them. In the teſticles of a young ſow, which had never been impregnated, he found, as in the others, glandular bodies; their triangular cavities were likewiſe filled with lymph; but no eggs could he diſcover in either of them. The veſicles of this young ſow were more numerous than in thoſe which had brought forth, or in thoſe which were impregnated previous to the time of examination. In

the teſticles of another ſow, which was far advanced in pregnancy, Valiſnieri found two of the largeſt glandular bodies, which were flaccid and empty, and others, of a ſmaller ſize, in their uſual ſtate. In others, which he diſſected when with young, he obſerved, that the number of glandular bodies always exceeded that of the foetuſes.

Valiſnieri, after his experiments upon ſows, repeats thoſe of Malpighius upon cows, and found them to be exactly conformable to truth, with this exception that he was never able to diſcover the egg which Malpighius imagined he had ſeen in the interior cavity of the glandular bodies. The experiments of Valiſnieri are not only numerous but accurate. Among other animals, he examined the ewe, and diſcovered, that ſhe has never a greater number of glandular bodies in her teſticles than of foetuſes in the uterus. In young ewes which had never been impregnated, there is but one glandular body in each teſticle; and, when one is emptied, another ſucceeds. This glandular body occupies the greateſt part of the teſticle; and, after it is emptied and diſappears, another begins to anſwer the purpoſes of a future generation. In the teſticles of a ſhe-aſs, he found veſicles as large as cherries. The teſticles of female wolves, dogs, and foxes, are covered with a membrane, like a purſe. In a bitch which began to be in ſeaſon, but had not been approached by the male, Valiſnieri found the internal of this moiſtened with a liquor that reſembled whey, and two glandular bodies in the right teſticle, which occupied nearly the whole extent of the teſticle. In each glandular body was a ſmall nipple, with a fiſſure, from which, without preſſing it, a liquor reſembling clear whey iſſued; he therefore concluded, that this liquor was the ſame which he found in the purſe. Into this fiſſure he blew with a pipe, and the whole glandular body ſwelled. He opened the body, and found an internal cavity which communicated with

with the nipple, and contained a conſiderable quantity of liquor. Valiſnieri was always in hopes that he would diſcover the egg; but, notwithſtanding all his reſearches, his hopes were uniformly fruſtrated. He diſſected another bitch four or five days after receiving the male, and found in the teſticles three glandular bodies perfectly ſimilar to the former. He every where ſearched for the egg, but was ſtill diſappointed. He diſcovered, by means of the microſcope, the glandular bodies to be a net-work compoſed of an infinite number of globular veſicles, which ſerved to filter the liquor that iſſued from the nipple.

Valiſnieri then opened another bitch which was not in ſeaſon; and, after trying to introduce air between the teſticle and the purſe, he found that it dilated like a bladder. Having removed the purſe, he diſcovered two glandular bodies on the teſticles, but they had neither nipple nor fiſſure, and no liquor diſtilled from them. In another bitch, that, two months before, had brought forth five whelps, he found five glandular bodies; but they were much diminiſhed in ſize, and began to diſappear without leaving any cicatrices. A ſmall cavity only remained in their centre, but it contained no liquor.

After theſe and many other ineffectual diſſections made upon a great variety of quadrupeds, Valiſnieri was deſirous of examining the teſticles of women. A young country-woman, who had been ſeveral years married, and was killed by a fall, afforded him the firſt opportunity. Though of a vigorous conſtitution, ſhe had never born any children. He endeavoured to diſcover whether the cauſe of her barrenneſs exiſted in the teſticles; and he found that all the veſicles

were

were filled with a blackiſh corrupted matter. In a girl of eighteen years of age, who had been educated in a convent, and had every mark of virginity, he found the right teſticle a little longer than the left: Its figure was oval, and its ſurface was ſomewhat unequal. This inequality was occaſioned by five or ſix veſicles which protruded on the outſide of the teſticle. One of theſe veſicles, which was more prominent than the reſt, he opened, and a quantity of lymph ruſhed out. A glandular ſubſtance, in the form of a creſcent, and of a reddiſh yellow colour, ſurrounded this veſicle. He cut the teſticle tranſverſely, and found a number of veſſels filled with limpid liquor; and he remarked, that the Fallopian tube of this teſticle was redder and ſomewhat longer than the other, as he had frequently obſerved in other animals, when in ſeaſon. In a girl, aged five years, he found the teſticles with their veſicles, their blood veſſels, and their nerves. In the teſticles of a woman of ſixty years, he diſcovered ſome veſicles, and the veſtiges of a glandular ſubſtance.

Valiſnieri, from theſe experiments and obſervations, infers, that the work of generation is carried on, and brought to perfection, in the female teſticles, which he perſiſted in regarding as ovaria, though he never could find eggs in them. He likewiſe remarks, that, for the impregnation of the egg, it is not neceſſary that the male ſemen ſhould enter the uterus. He imagines, that the egg, after being impregnated in the ovarium, eſcapes through the nipple of the glandular body; that it then falls into the Fallopian tube; and that it gradually deſcends, and at laſt attaches itſelf to the uterus. The ſpirit of the male ſeed, in his eſtimation, aſcends into the ovarium, penetrates the egg, and gives life and motion to the foetus which previouſly exiſted in it.

This

This ſyſtem of eggs, though it elucidates no branch of the ſubject, and probably has no foundation in Nature, would have received the univerſal aſſent of phyſicians, if, nearly about the ſame time, another hypotheſis had not ſolicited attention: It was founded upon the diſcovery of ſpermatic animalcules by means of the microſcope.

§ 8.—THIS diſcovery, which we owe to LEUWENHOEK and HARTSOEKER, was confirmed by Andrii, Valiſnieri, Bourguet, and many other philoſophers, and diligent obſervers. In male ſemen, the number of animalcules is ſo great, that it ſeems to be entirely compoſed of them; and Leuwenhoek tells us, that he ſaw many millions of them in a drop leſs that the ſmalleſt grain of ſand. Though none of them appear in females, they are found in the ſemen of all males, both in the teſticles, and in the veſiculae ſeminales. When ſemen is expoſed to a moderate heat, it thickens, and the movements of all the animalcules are ſuddenly ſtopped. But, when allowed to cool, it dilutes, and the animalcules continue to move till the liquor again thickens by evaporation. In proportion to the dilution of this fluid, the number of animalcules is augmented; and, when greatly diluted by the addition of water, the whole ſubſtance of the fluid ſeems to be compoſed of animals. When, by heat, or by drying, the motion of the animalcules is about to ceaſe, they ſeem to make a nearer approach to each other, to have a common circular motion in the centre of the ſmall drop under obſervation, and to periſh, all of them, at the ſame inſtant. But, when the quantity of liquor is greater, it is eaſy to perceive them dying in ſucceſſion. Theſe animalcules have been ſaid to be of different figures; but they are all oblong, thin, without any members, and move with rapidity in every direction.

Having examined the ſemen of a cock, Leuwenhoek perceived a number of animals ſimilar to river eels, which were ſo minute, that 50,000 of them were not equal in bulk to a grain of ſand. Of the animalcules in the ſemen of a rat, it required, he ſays, many millions to make the thickneſs of a hair. Leuwenhoek, from his numerous obſervations, was perſuaded that the whole ſubſtance of the ſemen was only a congeries of animalcules. He ſaw theſe animalcules in the ſemen of men, of quadrupeds, of birds, of fiſhes, and of inſects. In the ſemen of a man and that of a dog, he imagined he ſaw two ſpecies of animalcules, reſembling males and females. He opened a bitch which, ſome time before the experiment, had three times received the ſame dog. He could not perceive, with the naked eye, any male ſemen in the uterus or its appendages; but, by the aid of the microſcope, he found the ſpermatic animals of the dog in both horns of the uterus; which evidently proves, he remarks, that the male ſemen enters the uterus, or, at leaſt, that the ſpermatic animals of the dog had arrived there by their own motion, which enables them to paſs over the ſpace of four or five inches in half an hour.

Theſe and many other experiments of Leuwenhoek were repeated by ſeveral obſervers, who found them, in general, exactly conſonant to truth. Daleppatius, however, and ſome others, who were inclined to exceed Leuwenhoek in acuteneſs of viſion, alleged that, in the ſemen of a man, they diſcovered not only animals reſembling tadpoles, but Daleppatius inſiſts, that he ſaw one of theſe animals break through its coat or covering: It was then, ſays he, no longer an animalcule, but a real human body, in which he eaſily diſtinguiſhed the two arms and legs, the breaſt and the head. Daleppatius believed that he ſaw what he deſcribes; but he deceived himſelf; for this

this embryo, according to his account, was more completely formed, at the time of its tranſmigration from the ſtate of a ſpermatic worm, than it is in the womb of the mother at the end of the fourth or fifth week.

It is alleged by M. Andry, that he could diſcover no animalcules in human ſemen previous to the age of puberty; that they exiſt not in the ſemen of very old men; that there are few of them in thoſe who are affected with the venereal diſeaſe, and that thoſe few are in a languiſhing ſtate; that none of them appear to be alive in impotent perſons; and that the animalcules in the ſemen of men have a larger head than thoſe of other animals, which correſponds, he remarks, with the figure of the foetus and infant.

Leuwenhoek, Andry, and many others, exerted every effort to diſcredit the egg-ſyſtem. They diſcovered living animalcules in the ſemen of all males; they inſiſted that theſe animalcules could not be conſidered ſimply as inhabitants of this fluid, ſince the quantity of them was larger than that of the fluid itſelf, and ſince nothing ſimilar to them was to be perceived either in the blood, or in any other of the animal fluids: They maintained, that, as females furniſhed no animalcules, their fecundity was ſolely derived from the males; that the exiſtence of living animals in the ſemen threw more light upon the nature of generation than all the former diſcoveries on this intereſting ſubject; becauſe the greateſt difficulty in accounting for generation is to conceive how life is firſt produced, the future expanſion and growth of the parts being only acceſſory operations; and, conſequently, not a doubt could remain, that theſe animalcules are deſtined by Nature to become men, or perfect animals, according to the ſpecies.

It was not the firſt woman, according to this ſyſtem, but the firſt man, who contained the germs of the whole human race in his own body. The pre-exiſtent germs are no longer inanimate embryos locked up in eggs, and included, *in infinitum*, within each other. On the contrary, they are ſmall animals, or organized living *homunculi*, included in each other in endleſs ſucceſſion, and who, to make them men, or perfect animals, require nothing but expanſion of parts, and a transformation ſimilar to that of caterpillars when changed into winged inſects.

We have now pretty fully explained the two more modern ſyſtems, or rather theories, of the generation of animals, namely, the ſyſtem of eggs, and that of ſpermatic worms.

Neither of theſe ſyſtems received the aſſent of the celebrated COUNT DE BUFFON. Both ſyſtems, he remarks, ſuppoſe an infinite progreſſion, which is a mere illuſion of the brain. A ſpermatic worm, ſays he, is a thouſand million of times ſmaller than a man. If, therefore, the body of a man be aſſumed as a unit, that of a ſpermatic worm will be expreſſed by the fraction $\frac{1}{1,000,000,000,}$ a number which conſiſts of ten cyphers. But, as man is to a ſpermatic worm of the firſt generation in the ſame proportion as this worm is to a worm of the ſecond generation, the ſize of this laſt ſpermatic worm will be expreſſed by a number conſiſting of nineteen figures. In this fanciful calculation, he proceeds to the ſixth generation, which would require to be expreſſed by fifty-five cyphers. But, if this calculation, he continues, were carried on to the ſixteenth generation, the minuteneſs would exceed all the powers of expreſſion. Hence, he concludes, the probability of this hypotheſis vaniſhes in proportion as the object diminiſhes. The ſame calculation applies equally

equally to eggs as to ſpermatic worms; and the want of probability is common to both. Every hypotheſis which admits of an infinite progreſſion ought to be rejected not only as falſe, but as deſtitute of every veſtige of probability; and, as both the vermicular and ovular ſyſtems ſuppoſe an infinite progreſſion, they ſhould be for ever baniſhed from philoſophical ſpeculation, as well as from phyſiological diſcuſſion. Theſe ſyſtems, he proceeds, are liable to another objection. In the ovular ſyſtem, the firſt woman contained both male and female eggs. The male eggs could produce males only. But the female eggs muſt have contained millions of generations both of males and females. Hence every woman muſt have always poſſeſſed a certain number of eggs capable of being unfolded *in infinitum*, and another number, which could be unfolded once only, and could have no farther operation in the ſeries of exiſtence. The ſame obſervations are applicable to the vermicular ſyſtem. Hence, he concludes, that there is not the ſmalleſt degree of probability in either hypotheſis.

Another difficulty, continues our author, ſtill remains. It ariſes from the reſemblance of children ſometimes to the father, ſometimes to the mother, and ſometimes to both, and from the evident mongrel characters diſcoverable in mules and other irregular productions. If the foetus originates from the ſpermatic worm of the father, how ſhould the child reſemble its mother? If the foetus pre-exiſts in the egg of the mother, how ſhould the child reſemble its father? And, if the ſpermatic worm of a horſe, or the egg of a ſhe-aſs, be the origin of the foetus, how ſhould the mule partake of the nature and figure of both the horſe and aſs?

The objections, our author continues, to the ovular ſyſtem are not leſs important. If the foetus exiſted in the egg previous to inter-

courſe of the male and female, why is not the foetus ſeen in the egg previous to impregnation as diſtinctly as after it? Malpighius always found the foetus in eggs which had received impregnation, and, in unimpregnated eggs, he could diſcover nothing in the cicatrice but an unformed mole or maſs. It is evident, therefore, that the foetus is never formed till the egg has been impregnated. Beſides, we not only cannot diſcover the foetus in eggs before the intercourſe of the ſexes, but we have not been able to demonſtrate the exiſtence of eggs in viviparous animals. Thoſe naturaliſts who imagine that the ſpermatic worm is a foetus incloſed in a coat, or covering, are at leaſt aſcertained of the exiſtence of ſpermatic worms. But thoſe who maintain that the foetus pre-exiſts in the egg, have no evidence of the exiſtence of the egg itſelf; for the probability of their non-exiſtence in viviparous animals amounts almoſt to a certainty. Though the ſupporters of the ovular ſyſtem agree not as to what ought to be regarded as real eggs in female teſticles, they all admit, however, that impregnation is accompliſhed in the teſticles or ovaria. But they do not conſider, that, if this really happened, moſt foetuſes would be lodged in the abdomen, inſtead of the uterus? for, the ſuperior extremity of the Fallopian tube being unconnected with the ovarium, the ſuppoſed eggs would generally fall into the abdomen. This is well known to be a very rare phenomenon; and it is probable that it never happens but by ſome violent accident.

M. Mery, in the hiſtory of the Academy of Sciences, ſtated ſome objections to the egg-ſyſtem of generation. This dextrous anatomiſt inſiſts, with much propriety, that the veſicles found in the teſticles of females are not eggs; that they adhere ſo firmly to the internal ſurface of the teſticle, as not to admit of a natural ſeparation; and that, though they could ſeparate from the ſubſtance of the

the teſticle, it was impoſſible for them to eſcape from it, becauſe the texture of the common membrane which incloſes the whole teſticle is ſo ſtrong, that no man can conceive the poſſibility of its being pierced by a veſicle or gelatinous egg. As moſt anatomiſts and phyſicians were prepoſſeſſed in favour of the egg-ſyſtem, and imagined that the number of cicatrices in the ovaria correſponded with the number of foetuſes, M. Mery demonſtrated ſuch a quantity of theſe cicatrices in the teſticles of a woman, as, upon the ſuppoſition of the truth of this ſyſtem, would have implied a fecundity beyond all the powers of credibility. Other anatomiſts of the Academy, ſtimulated by theſe difficulties, made new reſearches. M. Duverney examined the teſticles of cows and ſheep, and maintained, that the veſicles were eggs, becauſe ſome of them adhered to the teſticles leſs firmly than others; and he ſuppoſed that they ſeparated entirely when they arrived at maturity. M. Mery replied, that this reaſoning was not ſatisfactory, becauſe theſe veſicles were never ſeen ſeparate from the teſticles. M. Duverney obſerved the glandular bodies upon the teſticles. He, however, never regarded them as parts eſſential to generation, but as accidental excreſcences, like gall-nuts on the leaves of the oak. M. Littre, whoſe prejudices were equally ſtrong in favour of the egg-ſyſtem, maintains, not only that the veſicles are eggs, but aſſures us, that he diſcovered in one of them a well-formed foetus, of which he could diſtinguiſh both the head and the trunk; and he has even ventured to give their dimenſions. From his own deſcription, however, it appears that the uterus was ſchirrous, that the teſticle was very much corrupted; and that the veſicle, or egg, which contained this pretended foetus, was ſmaller than uſual, &c.

We are told by Nuck, that he opened a bitch three days after copulation; that he drew out one of the horns of the uterus, and tied

it

it in the middle, to prevent all communication with the ſuperior and inferior parts of the Fallopian tube. He then replaced the horn of the uterus, and cloſed the wound. In twenty-four days afterwards, he again opened the wound, and found two foetuſes in the ſuperior part of the tube, that is, between the teſticles and the ligature; and no foetus was to be ſeen in the under part. In the other horn of the uterus, upon which there was no ligature, he found three foetuſes. This fact proves, ſays he, that the foetus does not originate from the male ſemen, but that it exiſts in the egg of the female. This experiment is ſingle; but, though it had been often repeated, and followed with the ſame event, the concluſion drawn from it is illegitimate. It proves no more than that a foetus may be formed in the ſuperior as well as in the inferior part of the horn of the uterus.

I have now laid before the reader a ſhort hiſtorical account of the theories and obſervations of the moſt reſpectable authors, both antient and more modern, who have written upon the important, but obſcure ſubject of the multiplication and ſucceſſion of animated beings. I ſhall, therefore, proceed to give the ideas of ſome of our contemporaries.

§ 9.—BUFFON'S experiments and reaſonings on the nature of generation merit attention. They are ingenious; but the reader muſt judge of their ſolidity. He alleges that all animals and vegetables are compoſed of an infinite aſſemblage of germs or organic living particles, which require only to be placed in certain circumſtances in order to produce an animal or vegetable of the ſame ſpecies. Theſe germs, or organic living corpuſcles, are all of a ſimilar figure and nature. In the ſame manner, ſalts, and ſome other mineral ſubſtances, are compoſed. A grain of ſea-ſalt is a cube conſiſting of an infinite number

number of ſmaller cubes, and theſe ſtill more minute, till, perhaps, we arrive at the primitive or conſtituent elements, which no glaſſes, nor any other human invention, can ever bring within the reach of our ſenſes. In the univerſe, our author remarks, the number of theſe living organized corpuſcles is infinite. Their conſtitutional ſubſtance is preciſely the ſame with that of thoſe organized bodies we ſee in Nature. For example, there is a vaſt profuſion of organic corpuſcles ſimilar to the animals with which we are acquainted. A combination of theſe forms an animal, in the ſame manner as a combination of ſmall cubes forms a grain of ſalt, or the combination of a number of vegetable corpuſcles produce a tree or a plant. But it is neceſſary to break down, or diſſolve, a grain of ſalt before we can diſcover the corpuſcles of which it is compoſed. The parts of a plant, or of an animal, muſt, in the ſame manner, be ſeparated, in order to diſcover, by means of vegetation or developement, the ſmall particles which enter into their compoſition. Every animal and vegetable ſubſtance is only a congeries of ſmaller animals and vegetables, though we are unable to make the diviſion. Hence, our author remarks, there exiſts in Nature multitudes of minute organized bodies ſimilar to the large organic beings which are exhibited in the world. Theſe ſmall beings, again, are compoſed of organic particles, which are common to animal and vegetable ſubſtances, give riſe to every part of organic matter, and are primitive and indeſtructible. An aſſemblage of their particles forms an organized body. Hence generation, or reproduction, is only a change of form occaſioned by the accumulation of ſimilar particles, and death, or diſſolution, is only a diviſion of this compound into its original and conſtituent parts.

In this manner, continues our author, ſeeds produce young trees, which formerly exiſted in miniature in their own ſubſtance. During the

the firſt year, at the top of the ſtems or trunks of trees, a ſmall bud appears, which contains a ſtem to be unfolded in the ſecond year. The ſame proceſs goes on annually with regard to the branches and leaves. Hence, he concludes, that the whole plant is an aſſemblage of ſimilar organic bodies. The more perfect and the more complex animals are, their reproduction is the more difficult, and their progeny the leſs numerous. During the growth of the body, all the organic particles extracted from food are totally abſorbed, and applied to augment the parts. For this reaſon, children are incapable of multiplying their ſpecies. But, when growth is nearly completed, the ſuperfluous molecules, or organic particles, are tranſmitted from all parts of the body to the teſticles and ſeminal veſſels, the reſervoirs appointed for them by Nature. At this period, the ſymptoms of puberty firſt begin to appear. Theſe particles, our author remarks, do not unite in the teſtes to form embryos. To accompliſh this effect, a mixture of thoſe belonging both to the male and female is indiſpenſable for the purpoſes of generation. When there are more male than female organic particles, the reſult is a male, and *vice verſa*. What determines theſe organic particles to come from all parts of the body, and to rendezvous in the teſtes? M. de Buffon anſwers, becauſe the organic particles are no longer able to penetrate the parts themſelves; they are rejected, and, of courſe, unite together by the ſame active force which formerly gave them the power of penetrating the different members of the body when in a more flaccid and ductile ſtate. In the courſe of circulation, every part attracts the particles which are moſt analogous to itſelf. After growth is completed, all the parts become more denſe; and, though the blood, as uſual, makes them an offer of organic particles, they are incapable of receiving them. The organic particles, therefore, being rejected by theſe parts of the body which formerly abſorbed them with

with avidity, are obliged to aſſemble in the teſtes, which are reſervoirs prepared by Nature for their reception.

Buffon made a great variety of experiments on the ſemen of different animals, which he diligently examined with the microſcope. The moving bodies in the ſemen, which Leuwenhoek, and indeed every man who choſe to view them, concluded to be animalcules, Buffon, in order, it ſhould appear, to deſtroy the homuncular ſyſtem, and to eſtabliſh a new one of his own, denies to be *animals*. He gives them, however, the appellation of *corps organiques vivans*, or *living organic bodies*. This may be a *diſtinction*; but we ſhall leave the reader to find out the *difference*. From theſe experiments our ingenious author reaſons in the following manner.

All animals, he remarks, are nouriſhed either by vegetable ſubſtances, or by other animals who feed upon vegetables. Hence there exiſts in Nature a matter common to both, which ſerves for the growth and nouriſhment of every thing that lives or vegetates. This matter effectuates growth and nouriſhment by aſſimilating itſelf to every part of the animal or vegetable, and by intimately penetrating the texture and *form* of theſe parts, which, ſays he, I have diſtinguiſhed by the appellation of an *internal mould*. When the quantity of this nutritive matter is more than ſufficient for the growth and expanſion of the animal or vegetable, it is detached from all parts of the body, and depoſited in one or ſeveral reſervoirs, under the form of a fluid. This fluid contains all thoſe particles which are analogous to the various parts of the body, and, of courſe, every thing neceſſary for the production, in miniature, of a being perfectly ſimilar to the firſt. This ſuperfluity of nutritive matter

does not take place, in moſt animals, till they have nearly acquired their full growth; for this reaſon, animals are not capable of multiplying their ſpecies before this period. When this nutritive and prolific matter, which is diffuſed through all nature, paſſes through the internal mould of an animal or vegetable, and finds a proper matrix or receptacle, it gives riſe to an animal or vegetable of the ſame ſpecies. But, continues our author, when this prolific matter does not find a proper matrix, it produces organized beings totally different from *animals* or *vegetables*, as the *moving* and *vegetating* bodies which appear in the ſeminal fluids of animals, and in the infuſions of vegetable ſubſtances *. If this reaſoning is not *abſurd*, I know not the meaning of the *word*. This prolific matter is compoſed of organic particles, which are always active. Their motions are ſtopped or arreſted by the brute parts of matter in general, and particularly by ſaline and oily ſubſtances; but, whenever they are diſengaged from theſe ſubſtances, they reſume their activity and produce different ſpecies of animals and vegetables. The ſpermatic animals may be ſeen, by the aſſiſtance of the microſcope, in the ſeminal fluids of both male and female animals. The ſemen of viviparous females is filtrated through the glandular bodies which grow upon their teſticles; and theſe glandular bodies contain, in their cavities, a conſiderable quantity of ſeminal fluid. Oviparous females have a ſeminal fluid which is ſtill more active than that of the viviparous. The ſemen of the female is ſimilar to that of the male. They decompoſe in the ſame manner; they contain ſimilar organic particles; and they exhibit the ſame appearances.

Of this organic and prolific matter, all animal and vegetable ſubſtances contain a great quantity. To diſcover its exiſtence, we have only

* Tranſ. of Buff. Vol. II. p. 347.

only to ſeparate it from the brute matter in which it is entangled, by infuſing animal or vegetable ſubſtances in water: The ſalts diſſolve; the oils ſeparate; and the organic particles are perceived by their movements. They are more numerous and active in the ſemen, than in any other animal fluids. After fleſh has been infuſed for a ſhort time in water, the organic matter appears under the form of moving bodies, which are nearly as large as thoſe in the ſeminal fluid. But, after the infuſion has been longer continued, the ſize of the organic particles is diminiſhed, and their motion is augmented; and, when the fleſh is entirely decompoſed or corrupted, the organic particles are extremely minute, and their motions are inconceivably rapid. When large quantities of this organic and prolific matter are collected in any part of an animal body where the matter is forced to remain, it there forms *living beings*, which we have always regarded as *real animals*! The taenia, the aſcarides, all the worms found in the veins, in the liver, in wounds, in pus, and moſt of thoſe which are formed in putrified fleſh, have no other origin. The eels in paſte, in vinegar, and all the pretended, our author obſerves, microſcopic animals, are only different forms aſſumed, according to circumſtances, by this active matter, which has a perpetual tendency to organization.

In infuſions of all animal and vegetable ſubſtances, this prolific matter firſt appears under the form of a kind of vegetation. We ſee it ſhoot into filaments, which grow and expand like plants. Their extremities and joints afterwards ſwell and burſt, to give paſſage to a multitude of moving bodies, which have ſome reſemblance to animals. Nature, it ſhould appear, commences all her operations by a kind of vegetable motion: This motion we perceive in a variety of microſcopic objects, and in the expanſion of the animal em-

bryo; for, at firſt, a fœtus poſſeſſes only a ſpecies of vegetable growth or motion. Sound food furniſhes none of theſe moving particles: Freſh meat, grain, fruits, &c. require to be infuſed ſome days before they exhibit any of theſe moving bodies. The more any ſubſtance is corrupted, decompoſed, or exalted, as pus, blighted grain, ſeminal fluids, &c. the moving bodies the ſooner make their appearance. In ſeminal fluids, they are entirely diſengaged from other matter; and a few hours infuſion only is neceſſary to diſcover them in pus, corrupted grain, ſtrong drugs, &c.

From theſe and ſimilar facts, our author infers the exiſtence of an organic animated matter, univerſally diffuſed through all animal and vegetable ſubſtances, and which equally ſerves for their nouriſhment, their growth, and their reproduction. Nutrition, he ſays, is effected by the intimate penetration of this matter through every part of animal and vegetable bodies; expanſion, or growth, is only a more extenſive ſpecies of nutrition, which proceeds as long as the parts are ductile, and capable of being ſtretched; and reproduction is an effect of the ſame matter, when it ſuperabounds in the body of an animal or vegetable. Every part of organized bodies ſends off to proper reſervoirs all the organic particles which are ſuperfluous for its nouriſhment. Theſe particles are perfectly ſimilar to the different parts from which they proceed, becauſe they were deſtined for the nouriſhment of thoſe parts. When the whole particles ſent off from every part of the body are aſſembled, they muſt neceſſarily form a ſmall body ſimilar to the original, becauſe every particle is ſimilar to the part from which it was detached. In this manner, every ſpecies of reproduction, where one individual only is requiſite, as that of trees, plants, polypi, vine-fretters, &c. is effected. This is alſo the firſt method employed by Nature for the reproduc-

tion

tion of ſuch animals as require the aid of different ſexes; for the ſeminal fluid of each ſex contains all the particles neceſſary for reproduction: But, among the larger animals, the mixture of both fluids, in a place ſuited to the expanſion and growth of the fœtus, is requiſite; and this place is the uterus of the female.

After reaſoning in this manner, from the facts enumerated by him, M. de Buffon draws the following concluſions: There are, therefore, ſays he, no pre-exiſting germs, or germs contained infinitely within each other. But there is an organic matter diffuſed through all animated nature, which is always active, and has a perpetual tendency to form, to aſſimilate, and to produce beings ſimilar to thoſe into which it enters. Hence the ſpecies of animals and of vegetables can never be exhauſted: As long as individuals ſubſiſt, the different ſpecies will be conſtantly kept up; they are the ſame now that they were three thouſand years ago. By their own powers they will perpetually exiſt, unleſs they be annihilated by the will of their Great CREATOR.

§ 10.—We ſhall now proceed to the theory of the ingenious C. BONNET. In his *Conſiderations ſur les Corps Organiſés*, Bonnet ſuppoſes that germs, or buds, exiſt in the uterus of the female, and contain the matter or rudiments of the fœtus; and that the impregnation of the male has no other effect than that of putting theſe germs in a condition proper for their evolution and growth. The animalcular ſyſtem, our author remarks, makes the germs, or rudiments of animals, reſide in the ſpermatic animalcules, and the uterus affords only a convenient nidus for beſtowing the warmth and nouriſhment neceſſary for the evolution of the parts. The exiſtence

of

of theſe animalculcs in females ſeems to deſtroy this hypotheſis, unleſs it ſhould be ſuppoſed that they copulate and produce a third being, which becomes the rudiments of a fœtus, or that they unite in numbers to compoſe a large homogeneous maſs. The farina of plants, and the ſemen of animals, are the nutritive particles deſtined by Nature for the growth and evolution of the original germs. Bonnet ſuppoſes that the germs, whether male, female, or neuter, as in bees, exiſt previouſly in the ovaria of the mother, and that the male ſemen only cheriſhes and unfolds what formly exiſted.

Bonnet endeavours to obviate ſome difficulties to which his theory gives riſe. For example, why ſhould mules reſemble both ſpecies from which they proceed? Theſe reſemblances, he obſerves, are ſeldom uniform, or take place in the ſame parts. It has, however, been remarked, that, in general, the body of a mule reſembles the female more than the male; but that the extremities have a greater reſemblance to thoſe of the male. On this branch of the ſubject, he confines himſelf chiefly to reſemblances in colour, which, he thinks, are eaſily accounted for by regarding the ſemen as a nutritious fluid. We know, ſays he, that the quality of the aliment has a great influence on the colour of organized bodies. By feeding on madder, the bones of fowls, and of other animals, are ſoon changed into a red colour. We can vary the ſhades of plants by making them abſorb different fluids of different colours.

But, he proceeds, it may be ſaid, that the colours impreſſed on the germ by the ſeminal fluid ſhould alter gradually, and at laſt vaniſh entirely. To remove this difficulty, our author replies, that the reflection of particular colours depends on the nature and texture of the parts; when theſe are determined, it is very probable that

that the colours remain, and that the nutritious particles conveyed to theſe parts receive the ſame tinges. A germ he defines to be the rudiment or ſketch of an organized body. This idea, he confeſſes, is not ſufficiently clear. But, he remarks, that we muſt either attempt a mechanical explanation of the mode in which organs are formed, which exceeds all human powers, or we muſt admit that the germ actually contain in miniature all the parts eſſential to the animal. The principal difference, then, between a germ and a real animal is, that the germ is compoſed ſolely of elementary particles, and that the texture formed by theſe particles is extremely condenſed; but that, in the animal, the elementary particles, by means of nutrition, are aſſociated with an infinity of other particles. The variety which takes place in all parts of animals, whether with regard to their proportions or conſiſtence, ſhows that the ſame variety exiſts in the elements from which they originated. The degree of extenſion in the different parts is proportioned to the power by which they were produced. This power, in the preſent ſubject, is the ſeminal or nouriſhing fluid.

To theſe general reflections, our author proceeds, I ſhall add ſome particular conjectures. 1. I ſuppoſe, ſays he, that, in the ſeminal fluid, the ſame ſpecies of elements exiſt as enter into the compoſition of the germ. 2. That elements of the ſame kind have a greater diſpoſition to union, than thoſe of a different nature. 3. That the texture, or tiſſue, of each part bears a certain proportion to the relative particles of the ſemen. 4. That the efficacy of the ſeminal liquor depends on the degree of its heat and motion, and on the number of the different kinds of elementary particles it contains. Upon theſe ſuppoſed principles, he remarks, the generation of mules by the junction of the aſs and mare may, in a certain degree,

gree, be explained. This production, ſays he, formerly exiſted in the ovaria of the mare under the form of a horſe. But how ſhould this horſe undergo ſuch a change? From whence proceed theſe long ears? Why is the tail furniſhed ſo ſcantily with hair? To theſe queſtions, he replies, that, though the elements of the ſeminal fluid of the aſs correſpond, in general, with thoſe of the germ, it contains a proportionally greater number of particles ſuited to unfold the ears. On the other hand, it has fewer particles neceſſary for expanding the tail.

SECT.

SECT. III.

Of Singularities in the Mode of Multiplying among certain Animals.

IN the firſt volume of this work, I have enumerated ſo many examples of the multiplication of animals, without the intervention of two ſexes, which, though ſtrictly connected with this ſubject, it is unneceſſary to repeat; and, therefore, muſt refer the reader to a peruſal of that part of the book where thoſe examples are to be found[1].

[1] Phil. of Nat. Hiſt. Vol. I. p. 30. &c.

SECT. IV.

Of Partial Reproduction—Some Animals, from peculiarities in their conſtitutions, have the power of reproducing parts of their bodies which have been lopped off—Suppoſed cauſes of this ſurpriſing faculty.

IN the more perfect animals, as man, quadrupeds, birds, &c. whoſe multiplication is regulated by general and ſimilar laws, if any member or part of their bodies is deſtroyed, it is impoſſible, it ſhould appear, for either art, or Nature herſelf, to repair the loſs. But, in ſome inferior animals, whoſe texture is more ductile, though deprived, by force or by accident, of particular members of their bodies, their conſtitutions have the power of reproducing the loſt parts, and of reſtoring them to their originally perfect ſtate; and, in ſome inſtances, when the body of an animal is divided, it gives riſe to as many individuals as there are diviſions, as in the polypus, &c.

The earth-worm, when cut into two or more portions, does not die. On the contrary, when the different portions are placed in proper circumſtances, each of them gradually becomes a perfect animal. BONNET informs us, that he cut a worm of this kind into two equal parts on the 27th day of July; and that, on the 15th of Auguſt, he perceived, at the poſterior part of the inſect to which the

head was attached, a ſlender vermicular appendage, about eight or nine lines in length. Its colour was brighter than the reſt of the body. It had the appearance of a ſmall worm proceeding from the extremity of the larger. This appendage, or rather this new poſterior part, was highly organized. It was compoſed of a ſucceſſion of very cloſe rings, upon the ſides of which the *ſtigmata*, or apertures deſtined for the purpoſes of reſpiration, were perceptible. What was ſtill more curious, the great artery, or that veſſel which, in inſects, performs the functions of the heart, was apparent. In this artery, from the one extremity of it to the other, the alternate motions, called *ſyſtole* and *diaſtole*, were perfectly evident. The circulation of the blood in this new production, in the ſame manner as in the reſt of the body, proceeded from the poſterior to the anterior extremity. In earth-worms, the blood is of a fine red colour, which gave M. BONNET an opportunity of diſtinguiſhing eaſily its motion and direction. At the end of a month and a half, from the operation, this new poſterior part, which at firſt was ſo ſlender, had acquired a thickneſs almoſt equal to that of the reſt of the body, and it had grown proportionally in length. Its colour was deeper, and the new inteſtines were full of earth, which is the food of that ſpecies of inſects. After what I have related, ſays BONNET, it muſt be acknowledged, that the earth-worm has the faculty of reproducing parts of its body after they have been cut off. The poſterior part, though lively and active at the end of nine months, ſhowed no ſymptoms of reproduction. After ſo long an abſtinence, it at laſt periſhed for want of food.

With a view to obſerve more particularly the reproduction of the anterior part, BONNET cut from an earth-worm the head and ſeveral rings. This experiment was begun about the end of July. To-

ward

ward the middle of Auguſt, the wound was perfectly cicatriſed; but no marks of reproduction appeared. The wound was circumſcribed by a pretty elevated border formed by the old fleſh, and made a kind of hollow in the middle reſembling a ſmall baſon. In a few days more, he obſerved, in the centre of this depreſſion, a white point, which, by gradually increaſing, aſſumed the form of a ſmall bud. On the twentieth day of September, this bud was lengthened, and terminated in a ſoft point. On the ſecond day of October, it was ſtill longer, and had aſſumed the appearance of a ſmall worm, which iſſued from the middle of the cicatrice. In the months of November and December, the new part continued to lengthen, and to grow proportionally thick. The death of the inſect put an end to farther obſervations. BONNET remarked ſimilar appearances in earth-worms which had been divided into three, four, and five portions. From the intermediate portions, both an anterior and poſterior part began to ſhoot at the ſame time. But the progreſs of the former, in equal times, was much greater than that of the latter. When the poſterior part had acquired three lines in length, the anterior part appeared only under the form of a ſmall bud; and, when the anterior part was between two and three lines long, the poſterior was at leaſt ſix lines, or half an inch. All theſe ſections of worms, however, died without reproducing a complete anterior part.

BONNET made ſimilar experiments on certain ſpecies of worms which live in freſh waters. They afford an example of a much more rapid reproduction than can be obtained from the earth-worm. Sections of theſe worms, in a few days, become complete animals. The anterior part ceaſes to grow as ſoon as it has acquired the length of a line, or a line and a half. The poſterior part, on the contrary, ſometimes ſtretches out to the length of ſeveral inches. Portions,

even

even cut from the middle of the body, reproduce a new head and a new tail. Another ſpecies of freſh-water worm is of a whitiſh or aſh colour. It is remarkable, that when BONNET cut tranſverſely the body of this worm into two or ſeveral portions, each portion, at its anterior extremity, reproduced a tail inſtead of a head. This tail, as might be ſuſpected, was not a head more than commonly ſlender. It was a well-formed tail, in which the anus was diſtinctly viſible. This reproduced part, the worm did not uſe either for the purpoſes of moving or of taking food. It only made vibrations occaſionally from right to left, but without the ſmalleſt attempt to progreſſive motion. It is remarkable, that in this tail, inſtead of a head, the circulation of the blood did not change its direction, but continued, as uſual, to move from the poſterior to the anterior part of the body. It is ſtill more remarkable, that the ſections of theſe worms, which reproduce a tail inſtead of a head, never receive any nouriſhment. Their ſtomach and inteſtines, though the anomalous creatures ſometimes lived ſeven months, were always tranſparent, and never contained any food.

But theſe inſtances of reproduction are confined to very ſmall animals. I now give an example of regeneration of parts lopped off in an animal prodigiouſly large, when compared with the polypus, or the freſh-water worms, formerly deſcribed.

Long before the hiſtory of the polypus was known, philoſophers admired the reproduction of the claws of the cray-fiſh, a ſpecies of lobſter. But no perſon has traced the progreſs and circumſtances attending this reproduction with equal exactneſs and ſagacity as the celebrated M. DE REAUMUR *.

The

* Mem. de l'Acad. Royale des Sciences, anno 1712.

The claws of the cray-fiſh, reckoning from the end of the pincher, conſiſt of five articulations, at the fourth of which the claw breaks moſt frequently, and here it is alſo moſt eaſily reproduced. When the claw, whether by accident or deſign, has been broken at or near this articulation, the part which remains attached to the body exhibits a round ſhelly opening or tube. This tube is occupied entirely with a fleſhy ſubſtance. In a day or two, eſpecially if the experiment is made in ſummer, a red membrane, like a piece of cloth, ſhuts up the aperture. This membrane is at firſt plain; but, in four or five days, it aſſumes a convexity, which gradually augments, till it takes the appearance of a ſmall cone, which exceeds not a line in heighth. It continues, however, to ſtretch out; and, in ten days, it is ſometimes more than three lines, or about a quarter of an inch, high. It is not hollow, but filled with fleſh, and this fleſh is the baſis or rudiments of a new claw. The membrane which covers the fleſh performs the ſame office to the young claw as the membranes do to the foetus of the larger animals. It extends in proportion as the animal grows; and, as it is pretty thick, we can perceive nothing but a lengthened cone. When fifteen days are elapſed, this cone inclines toward the head of the animal. In a few days more, its curvature increaſes, and it begins to aſſume the appearance of a dead claw. This claw, though, at the end of a month or five weeks, it has acquired the length of ſix or ſeven lines, which is more than half an inch, is ſtill incapable of action. The membrane in which it is incloſed becoming gradually thinner in proportion as it extends, gives an opportunity of obſerving the parts of the claw, and we now perceive that this conical ſubſtance is not a ſimple congeries of fleſh. The moment is now arrived when the claw begins to be brought forth. The membrane at laſt burſts, and the new claw, though ſtill ſoft, appears without incumbrance or inveſtment. In a few days more,

SECT. V.

General Reflections and Obſervations.—Suppoſed Effects of the Imagination upon pregnant Animals.

I HAVE now given an hiſtorical account of this moſt intricate ſubject, which has occupied the attention of great and learned men both in antient times and in our own. Before concluding, I muſt, however, be indulged with a few remarks.

The mode employed by Nature for multiplying animals, by the commixture of ſexes, though inveſtigated with anxiety by ingenious men for many ages, is ſtill, and muſt for ever remain a myſtery. I ſhall not diſturb my readers with particular remarks upon the various theories of which I have given abridged, but, I hope, ſatisfactory views. Much muſt be left to their own reflection. It may, however, be obſerved, upon the whole, that great labour and great ingenuity have been exerted in order to elucidate a ſubject ſo intereſting, and ſo calculated to excite the curioſity of beings endowed with any conſiderable portion of rational powers.

The moſt plauſible theories are thoſe of HARVEY, LEUWENHOEK, and BUFFON.

HARVEY's idea of eggs is ingenious, and founded on a ſtrong analogy. But the facts he produces ſeem not ſufficient to ſupport the hypotheſis he has adopted. If we reflect on oviparous animals, from the humming-bird to the largeſt of the feathered tribes, we ſhall perceive that the eggs bear ſome proportion to the magnitude of the animal which gives birth to them. But in man and the larger quadrupeds, what HARVEY, and many other writers of reputation, have choſen to denominate *eggs* in their ovaria, are almoſt infinitely diſproportioned, by their minuteneſs, to the magnitude of the animals which are ſuppoſed to proceed from them. An elephant, or even a human being, produced from an *egg* not ſo large as a *pea*, requires a degree of faith that few men poſſeſs. Here the analogy between real oviparous animals and the larger quadrupeds ſeems too diſtant, and even too ridiculous, to obtain general credit. Beſides, how is this egg, after impregnation, to enter the Fallopian tube, and be, through this channel, conveyed into the uterus? The Fallopian tubes have no immediate connection with the ovaria. But we are told, that, in the moment of impregnation, the *fimbriae*, or fringed mouths, of the Fallopian tubes, embrace the ovaria, ſwallow an egg, and tranſmit it to the uterus, where it is cheriſhed, hatches, and, in proper time, produces a living animal! Whoever is capable, after conſidering the ſtructure of the parts, of believing this ſtrange proceſs, ſeems to have more faith than is neceſſary to conſtitute a good Muſſelman.

LEUWENHOEK's vermicular theory is ſtill more complicated, and leſs intelligible. That animalcules, or moving bodies, really appear, by the aſſiſtance of the microſcope, in the ſemen of animals, is an inconteſtible fact. But our author conſiders theſe moving bodies as real animals, according to the ſpecies, which require only a proper

nidus

nidus for their growth and perfection of their parts. LEUWENHOEK ſuppoſes that, when one of theſe animalcules gets admittance to the uterus, its parts, which formerly exiſted, are gradually unfolded till at laſt it becomes an animal completely fitted to ſee the light, and to perform the various functions of life. He tells us, that, in the ſemen of ſome ſpecies, millions of animalcules are not equal in bulk to a grain of ſand, and that, in others, many millions of them would not make the thickneſs of a hair. In the ſeeds of plants, Nature, for many obvious reaſons, is very profuſe. But, in the animal kingdom, no ſuch reaſons exiſt. In one impregnation, according to LEUWENHOEK's hypothecis, millions of animated beings periſh, when one only has the good fortune to ſurvive. What are the devaſtations of all the hoſtile armies ſince the creation of the world, when compared to this immenſe waſte of animals, even in the life of a ſingle man, or rather in the impregnation of a ſingle female?

The idea of animalcules exiſting in the ſemen of males, and of afterwards becoming perfect animals, does not in the ſmalleſt degree advance our knowledge of the multiplication of ſpecies. The queſtion ſtill recurs. What gives riſe to theſe animalcules? How are they produced? Do they conſiſt of males and females? Suppoſing they did they would only multiply their own number, from which nothing farther, in the ordinary courſe of nature, could poſſibly proceed With regard to this vermicular hypothecis, it ſhall only be remarked, that if the ſpermatic worms of men were the rudiments of real human beings, which required only a proper ſituation for having their parts expanded, why ſhould myriads of them be deſtroyed, and only a favoured one be ſelected, and at laſt brought to perfection? Animation, particularly in the human ſpecies, implies a ſoul, or a thinking principle. What, it may be aſked, becomes of

thoſe millions of ſouls which are daily, to us at leaſt, loſt? Are they annihilated? If ſo, why create ſuch ſuperfluous multitudes for no other ſeeming purpoſe but to hurry them prematurely out of exiſtence? The reader, I imagine, is now completely tired of this ridiculous *worm-theory* of generation, I ſhall, therefore, make a few remarks upon that of my late learned, reſpected, and moſt ingenious friend and correſpondent, the COUNT DE BUFFON.

This illuſtrious author, fully perſuaded that the notion of thoſe moving atoms, diſcernible in the ſemen, being real animals was abſurd, adopts an hypotheſis, which, though apparently different, amounts nearly to the ſame thing. To what LEUWENHOEK and others call *animalcules*, BUFFON, by a circumlocution, gives the denomination of *corps organiques vivantes*. Theſe moving particles, he ſays, have a conſtant tendency to unite, and to form larger animated bodies of a ſimilar nature. The only difference between LEUWENHOEK's *worms*, and BUFFON's *living organic particles*, ſeems to be this. The former makes a ſingle *worm*, or *homunculus*, ſufficient to produce a perfect animal. The latter takes a wider range, and ſuppoſes a numerous congeries of them neceſſary to accompliſh the ſame end. The idea, that a number of *living* organic bodies ſhould unite, and form only *one living* organized body, ſeems to be very remote from any known analogy; and no man will pretend to demonſtrate the ſuppoſed fact.

Whoever peruſes theſe ſketches of the various theories of the generation of animals which have hitherto been invented, will probably require no other arguments to convince him that philoſophers and phyſicians are ſtill as ignorant of this myſterious proceſs of Nature as they were in the days of HOMER.

Sup-

Suppoſed Effects of the Imagination upon pregnant Animals.

THIS branch of the ſubject, to ſome readers, may ſeem too contemptible and too ridiculous to be treated of in a ſerious manner. But it is the duty of philoſophers to remove prejudices, and eſpecially ſuch as are really hurtful to mankind. In this country, at leaſt, there is not a deeper rooted prejudice than that ſtrawberries, fruit of any kind, a mouſe, &c. when thrown at a pregnant woman, produce, by means of her imagination, or apprehenſion, marks ſimilar to theſe objects in the part of the foetus correſponding to that on which the mother was ſtruck. Theſe marks are even ſuppoſed to be transferable from one part of the body to another For example, when any thing is thrown at a pregnant woman, either by accident or deſign, if ſhe inſtantly puts her hand on her hip, this action, it is firmly believed, transfers the mark to that part of the child's body, and prevents the more expoſed parts, as the face and hands, from being deformed.

But the ſuppoſed effects of imagination upon the foetus are not confined to ſubſtances thrown at the mother. Fear, love, or any ſtrong deſire, are ſaid to produce derangements in the foetus. For this reaſon, pregnant women are carefully prevented from ſeeing negroes, apes, or any other animal that may create terror or ſurprize. We are told that a woman in Paris, who happened to be with child when ſhe ſaw a criminal broken upon the wheel, was ſo ſtruck with the dreadful ſpectacle, that the bones of the infant ſhe afterwards produced were preciſely in the ſame condition with thoſe of the unfortunate ſufferer. Similar effects are apprehended when a woman, in this condition, has a ſtrong deſire to eat particular fruits,

or

or is affected with any other appetite which, at the time, cannot be gratified.

That pregnant women, agitated by any violent paſſion, placed in dangerous ſituations, or frightened by ſome ferocious animal, ſhould occaſionally produce deformed or even maimed children, is by no means impoſſible. Between the mother and the fœtus the connection is ſo intimate, that a violent agitation in the ſpirits and blood of the former may be communicated to the latter, and give riſe to diſorders which the parts of the mother are able to repel, but to which the more delicate texture of the fœtus muſt yield. We daily perceive involuntary motions extended to much greater diſtances than from the mother to the child in her womb. When a man walking before us makes a falſe ſtep, we aſſume naturally that poſition of our bodies which he ſhould take, in order to prevent himſelf from falling. We cannot ſee other men ſuffer, without feeling a part of their pain. This is the bond by which Nature attaches mankind to each other. Pleaſure and pain are the two maſters of this world. Without the one, few animals would take the trouble of continuing the ſpecies: If we had no dread of the other, many men would not chuſe to protract their exiſtence.

But the effects of terror muſt not be confounded with thoſe commonly ſuppoſed to be produced by a ſlight and momentary imagination of the mother. Terror may occaſion great derangements in the ſoft texture of a fœtus; but theſe derangements have no reſemblance to the objects by which they are produced. It is much more probable, that the terror occaſioned by a tiger, or other rapacious animal, ſhould produce the death of the child, or great derangements in its parts, than that the ſame terror ſhould give riſe to ſpots and claws

claws reſembling thoſe of the tiger. Beſides, an infant brought forth with its bones broken as if upon the wheel, would not be ſo ſurpriſing, as the mark of a cherry proceeding from no other ſource than becauſe the mother wiſhed to eat a cherry. Nothing, however, is more common than marks which are ſuppoſed to derive their origin from the longings of the mother. A mark of this kind is ſometimes called a *cherry*, ſometimes a *raiſin*, and ſometimes a *fiſh!* After examining a number of theſe marks, M. MAUPERTUIS acknowledges, that he never ſaw one which could not eaſily be reduced to ſome excreſcence, or to ſome accidental blotch on the ſkin *. The relation of mothers, that they remembered, during their pregnancy, to have had certain fears or deſires, merits but little attention; for they never recollect to have had theſe fears or deſires till they have brought forth a child with ſome uncommon mark on its body. Their memory then ſupplies them with whatever they want. If the mark has ſome fancied reſemblance to a fruit or to an animal, they inſtantly recollect, that they longed for the one, or were frightened by the other. It is not indeed wonderful, or rather it is highly probable, that, in the courſe of nine months, any woman, whether pregnant or not, ſhould be afraid of ſome animal, or have a deſire to eat a particular kind of fruit.

In theſe ſuppoſed effects of imagination, it may be aſked, Why are not the impreſſions, and often cruel ones, of the whip, ſeen upon the offspring of mares, and ſhe-aſſes? It may, perhaps, be alleged that the inferior animals have no imagination. No perſon however, who obſerves the œconomy of the moſt common quadrupeds can entertain a doubt that they are poſſeſſed of this power; but they have not the folly to exerciſe it in a manner ſo abſurd. A mare,

* Oeuvres de Maupertuis, Tom. II. p. 78. 79. Art. Venus Phyſique.

mare, a ſhe-aſs, or a cow, though hunger often obliges them to long violently for particular kinds of food; yet their offspring never exhibit marks of graſs, of hay, of cabbages, or of turnips.

I ſhall conclude this ſubject with a few obſervations, the principal intention of which is to remove the prejudices juſt mentioned, and, of courſe, to prevent, if poſſible, the apprehenſions of females ariſing from imaginary, but often hurtful, cauſes. Though the human fœtus is, in ſome meaſure, equally independent of the mother, as the egg is independent of the hen by which it is covered; yet, it is aſſerted that, whatever affects the mother produces a ſimilar effect upon the fœtus, and that the impreſſions received by the one are communicated to the other. To this imaginary influence all thoſe reſemblances, and marks, which appear on the ſkin of particular children, have been attributed. 'Many of theſe marks,' ſays the COUNT DE BUFFON *, 'I have examined, and they uniformly appeared to be occaſioned only by a derangement in the texture of 'the ſkin. Every mark muſt neceſſarily have a faint reſemblance to 'ſomething or other: But ſuch reſemblances, I am perſuaded, depend more on the imagination of thoſe who ſee them, than upon 'that of the mother. On this ſubject, the marvellous has been 'puſhed to an extreme degree. The fœtus has not only been ſaid 'to bear the real repreſentations of the appetites of the mother, but 'that, by a ſingular ſympathy, the marks which repreſent ſtrawberries, cherries, &c. aſſume a deeper colour during the ſeaſon of 'theſe fruits. A little attention, however, will convince us, that 'theſe changes of colour are more frequent, and that they happen 'whenever the motion of the blood is accelerated, whether it be 'occaſioned by the heat of ſummer, or by any other cauſe. The 'marks

* Tranſlat. Vol. II. p 330.

'marks are always either yellow, or red, or black; becauſe the 'blood gives theſe colours to the ſkin when it enters in too great 'quantities into the veſſels. If theſe marks were occaſioned by the 'appetites of the mother, why are not their forms and colours as 'various as the objects of her deſires? What a multitude of ſtrange 'figures would be exhibited, if all the whimſical longings of a mo-'ther were written on the ſkin of the child? As our ſenſations 'have no reſemblance to the objects which excite them, it is im-'poſſible that deſire, fear, horror, or any other paſſion or emotion, 'can produce real repreſentations of the objects by which they are 'occaſioned. An infant being, in this reſpect, equally independent 'of the mother as the egg is independent of the hen that ſits upon 'it, I ſhould be equally induced to believe, that the imagination of 'a hen, which ſaw by accident a cock's neck twiſted, ſhould pro-'duce wry-necked chickens from the eggs ſhe was hatching, as that 'a woman, who ſaw a man broke upon the wheel, ſhould produce, 'by the mere force of imagination, a child with all its limbs 'broken.'

Even if this laſt fact were well aſcertained, it could never be occaſioned by the imagination of the mother. What is the effect of horror? An internal movement, or perhaps a convulſion of the mother's body, which might alternately compreſs and dilate the uterus. What would be the conſequence of ſuch a commotion? Nothing, ſurely, ſimilar to its cauſe: For, if the commotion was very violent, the fœtus might have ſome of its parts deranged, or even its life might be extinguiſhed. But, is it poſſible to believe that this agitation ſhould produce in the fœtus any thing ſimilar to the thoughts or feelings of the mother? Among the infinite combinations of which Nature is capable of forming, that arrangements, both in animated

and inanimated beings, of peculiar and extraordinary kinds ſhould ſometimes happen, is not an object of wonder. Of the numberleſs children, therefore, which daily come into the world, one may occaſionally appear with two heads, with four legs, or with the bones of all its members broken, or rather not fully united. The fœtus, as formerly remarked, poſſeſſes nothing in common with the mother. Its organs, its functions, its blood, are all peculiar to itſelf. The only matter it derives from the mother is the nutritive lymph which is ſecreted by the uterus. If this lymph is any how vitiated, if it be tainted with the venereal virus, the fœtus receives the infection; and it is reaſonable to think, that all diſeaſes proceeding from vitiated humours may be communicated from the mother to the child. The ſmall pox is often communicated in this manner; and we have too many examples of children, immediately after birth, becoming innocent victims of their parents debauchery.

We ſhould not have dwelt ſo long upon this ſubject, were it not for an earneſt deſire to remove a hurtful, and ſometimes a dangerous prejudice, to which women, even in the higheſt ranks of life, are unfortunately ſubjected. This prejudice, from whatever ſource it derived its origin, is very antient. In the 30th chapter of Geneſis, we find the following moſt curious paſſage, which is an interlocutory bargain between Laban and Jacob: 'And it came to paſs, when 'Rachael had born Joſeph, that Jacob ſaid unto Laban, ſend me 'away, that I may go into mine own place, and to my country. 'Give me my wives and my children, for whom I have ſerved thee, 'and let me go; for thou knoweſt the ſervice which I have done 'thee. And Laban ſaid unto him, I pray thee, if I have found 'favour in thine eyes, tarry; for I have learned, by experience, that 'the Lord hath bleſſed me for thy ſake. And he ſaid, Appoint me my

'my wages, and I will give it. And he ſaid unto him, Thou 'knoweſt how I have ſerved thee, and how thy cattle was with me. 'For it was little which thou hadſt before I came, and it is now in-'creaſed into a multitude; and the Lord hath bleſſed thee ſince my 'coming; and now, when ſhall I provide for mine own houſe 'alſo? And he ſaid, What ſhall I give thee? And Jacob ſaid, 'Thou ſhalt not give me any thing; if thou wilt do this thing for 'me, I will again keep and feed thy flock. I will paſs through all 'thy flock to-day, removing from thence all the ſpeckled and ſpot-'ted cattle, and all the brown cattle among the ſheep, and all the 'brown and the ſpotted and ſpeckled among the goats, and of ſuch 'ſhall be my hire. So ſhall my righteouſneſs anſwer for me in 'time to come, when it ſhall come for my hire before thy face: 'Every one that is not ſpeckled and ſpotted amongſt the goats and 'brown amongſt the ſheep, that ſhall be accounted ſtolen with me. 'And Laban ſaid, Behold, I would it might be according to thy 'word. And he removed that day the he-goats, that were ring-'ſtraked and ſpotted, and all the ſhe-goats that were ſpeckled and 'ſpotted, and every one that had ſome white in it, and all the 'brown among the ſheep, and gave them into the hands of his ſons. 'And he ſet three days journey betwixt himſelf and Jacob: And 'Jacob fed the reſt of Laban's flock. And Jacob took him rods of 'green poplar, and of the haſel and chefnut tree; and pilled white 'ſtrakes in them; and made the white appear which was in the 'rods. And he ſet the rods which he had pilled before the flocks 'in the gutters in the watering troughs, when the flocks came to 'drink; that they ſhould conceive when they came to drink. And 'the flocks conceived before the rods, and brought forth cattle ring-'ſtraked, ſpeckled, and ſpotted. And Jacob did ſeparate the lambs, 'and ſet the faces of the flocks toward the ring-ſtraked, and all the

'brown in the flock of Laban; and he put his own flocks by themſelves; and put them not unto Laban's cattle. And it came to paſs whenſoever the ſtronger cattle did conceive, that Jacob laid the rods before the eyes of the cattle in the gutters, that they might conceive among the rods. But when the cattle were feeble, he put them not in; ſo the feebler were Laban's, and the ſtronger Jacob's.'

We ſhall make no obſervations on this remarkable paſſage, but, after what has been formerly ſaid on the ſubject, leave it entirely to the judgment of the reader.

CHAP.

CHAPTER III.

SECT. I.

Of Mules, or the anomalous productions of Nature—Mules ſprung from the horſe and aſs not entirely unprolific—Of the Jumar, an animal ſuppoſed to be produced between the bull and mare—Different ſpecies of ſmall birds unite, and their progeny retain the power of multiplication.

THE anomalous productions of Nature excite aſtoniſhment in the vulgar, and call forth the reaſonings of the ſpeculative. From the ſingularity of their appearances, and that love of oddity to which moſt men are addicted, it is natural to imagine, that this ſubject ſhould have long ago been exhauſted. But the concluſion, however plauſible, is by no means juſt; for the production and occonomy of mules have never obtained a philoſophical diſcuſſion. Much has been written; many theories have been fabricated; but the number of experiments bear no proportion to the quantity of ſpeculation. The maxim, That mules cannot perpetuate their kind, is eſtabliſhed. But, like many other maxims, it has been rendered general, more from the indolence of mankind, than from their inquiry into the genuine operations of Nature.

The

The COUNT DE BUFFON, however, in a ſupplementary volume to his hiſtory of quadrupeds, has given a conſiderable degree of probability to the fertility of mules. He laments, that, in the production of them, few experiments have been made, and that even theſe have been confined to animals poſſeſſed of the weakeſt prolific powers. Some ſpecies have a natural antipathy to others. But, when managed with addreſs, theſe antipathies may be removed. BUFFON endeavoured to procure a conjunction between the dog and the wolf: He failed in the attempt. But, in the year 1773, LE MARQUIS DE SPONTIN BEAUFORT ſucceeded. From a ſhe-wolf and a maſtive dog, he obtained four puppies at one litter *. Theſe animals, who had been brought up in familiarity with each other, joined ſpontaneouſly. Inſtances are even recorded of mutual attachment between a dog and a ſow, though their attempts were abortive †. The exiſtence of the *jumar*, a production between a bull and a mare, or between a bull and a ſhe-aſs, though particularly deſcribed by ST LEGER, and ſome other writers, has not obtained general credit. But that a bull and a mare ſpontaneouſly joined, we have direct evidence from BUFFON ‡. 'In the year 1767,' ſays this ingenious author, 'and ſome ſucceeding years, the miller at my eſtate of 'Buffon kept a mare and a bull in the ſame ſtable, who contract-'ed ſuch a paſſion for each other, that, as often as the mare came in 'ſeaſon, the bull covered her three or four times every day. Theſe 'embraces were repeated during ſeveral years, and gave the maſter 'of the animals great hopes of ſeeing their offſpring: Nothing, how-'ever, reſulted from them. All the inhabitants of the place were 'witneſſes

* Supplement a l'Hiſt. des Anim. Quadruped. par BUFFON, p. 9. 10. & ſeq. and Tranſ. vol. 8. p. 10.

† Supplement, &c. par BUFFON, p. 35. and Tranſ. vol. 8. p. 10.

‡ Tranſ. vol. 8. p. 37.

'witneſſes to this fact, which proves, that, in our climate at leaſt, 'the bull cannot procreate with the mare, and renders this kind of 'jumar extremely ſuſpicious. I have not equal evidence to oppoſe 'to the ſecond kind, which Dr SHAW ſays proceeds from the jack-'aſs and cow. I acknowledge, that, though the diſſimilarities in 'ſtructure appear to be nearly equal in both caſes, the poſitive teſti-'mony of a traveller ſo well informed as Dr SHAW, ſeems to give a 'greater degree of probability to the exiſtence of this ſecond kind of 'jumar than we have for the firſt. With regard to the third jumar, 'proceeding from the bull and ſhe-aſs, I am perſuaded, notwithſtand-'ing the authority of MIROILE, that it has no more exiſtence than 'the one ſuppoſed to be produced by the bull and mare. The nature 'of the bull is ſtill farther removed from that of the ſhe-aſs, than 'from that of the mare. And the unfertility of the mare and bull, 'which is aſcertained by the above examples, ſhould apply with 'greater force to the union of the bull and aſs.'

Some of the antients mention the fecundity of common mules ARISTOTLE tells us, that the mule coupled with the mare, and produced an animal called by the Greeks *hinnus* or *ginnus*, and that the female mule readily conceived, but ſeldom brought her offſpring to perfection *. The ſame fact is mentioned by PLINY as recorded in the Roman Annals.

But BUFFON produces evidence of a leſs equivocal nature. M. DE BORY communicated to the COUNT DE BUFFON a certificate, atteſted by many credible witneſſes, that, in the month of May 1769, a female mule brought forth a well formed-foal in the iſland of St

* Ariſt. Hiſt Anim. lib. 6 c. 24.

St Domingo *. He adds, that, on account of a fall which happened to the mother, the foal was hurt, and died an hour after birth; and that its ſkin, according to his information, was tranſmitted to Dr MATTY, then ſecretary to the Royal Society of London †. M. DE BUFFON mentions ſeveral examples of the ſame kind from Spain and Italy, though he acknowledges that they are not ſo well atteſted as the former ‡. From theſe facts he concludes that hybrids, or mules, produced even from the moſt comparatively unprolific quadrupeds, are not abſolutely barren.

M. DE BUFFON farther remarks, that 'mules never produce in cold climates, ſeldom in warm regions, and ſtill more ſeldom in *temperate countries* §.'

The inſtances of prolific powers in mules, properly authenticated, are indeed few. But this circumſtance is perhaps more owing to the prejudices and to the indolence of mankind than to the actual ſterility of the animals. Even in our own country, we have lately had an inſtance of the prolific powers of a ſhe-mule. She was impregnated ſpontaneouſly by a horſe, and produced a very ſtrong foal. The animal, however, was allowed to periſh from a ſuperſtitious notion, that it was an ominous monſter, and would bring diſcredit to the farmer's cattle, as well as to thoſe in his neighbourhood. This event happened in the county of Forfar, which is ſituated in the north of Scotland. Though I publiſhed an authenticated account of this uncommon fact in the eighth volume of my Tranſ-

* Buffon, Supplem. à l'Hiſt. des Quadrup. p. 16, 17. and Tranſlat. Vol. VIII. p. 15.

† Ibid. p. 18. and Tranſlat. Vol. VIII. p. 16.

‡ Ibid. and Tranſlat. Vol. VIII. p. 17.

§ Ibid. p. 19. and Tranſlat. Vol. VIII. p. 18.

Tranſlation of Buffon, it will not be improper, for the ſatisfaction of my readers, to ſubjoin, verbatim, the authentication in a note

Birds,

* Having heard that a mul , belonging to Mr David Tullo, farmer in Auchtertyre, in the county of Forfar, had, ſome years ago, brought forth a foal I tranſmitted a few queries to be put to Mr Tullo, and requeſted that his anſwers might be legally atteſted by a magiſtrate. This requeſt was chearfully complied with; and the following is an exact copy of the queries, anſwers, and atteſtations

Interrogatories to be put to Mr Tullo, tenant in Auchtertyre, pariſh of Newtyle, and county of Forfar, with his anſwers thereto.

1*mo*, Had you ever a ſhe-mule? At what period? Is it true that the mule had a foal? At what time was ſhe covered; and when did ſhe foal?

Anſwered by Mr Tullo. That he bought a ſhe mule about twenty years ago: That ſhe was conſtantly in ſeaſon for a horſe: That, about ſome years thereafter, he gave her a horſe; and that ſhe, thereafter, gave him a foal about the 10th of June. The mule's price was four pounds five ſhillings Sterling.

2*do*, What was the colour of the foal? Was there any thing particular in its figure?

Anſwer: The foal was exactly the colour of its mother, inclined to black with a very large head, big ears, and ſmall tail; and the declarant thinks, had its head been weighed when foaled, it would have weighed nearly as much as its body.

3*tio*, How long was the animal allowed to live?

Anſwer: The next day after the mule foaled, it was ſent, with its mother, to the Loch of Lundie, in order to let the foal die, as the declarant could not want the mule's work, and the mother ſeemed not fond of the foal: That it was accordingly left, and next day came to Auchtertyre, about two miles diſtance, over a hill, with the cattle of Auchtertyre, that had been grazing near to that place, and was drowned in a ditch the day following.

4*to*, Was its ſkin preſerved, or the head, or any other bones of the ſkeleton? Could any part thereof be ſtill found?

Birds, in general, are more prolific, and likewiſe more ardent in their amours, than quadrupeds. A cock, when excluded from hens, attacks another cock, a capon, a turkey, or a duck. The ſmaller birds fly to females of a different ſpecies when deprived of their own. Commixtures of this latter kind have been repeatedly tried, and the mongrel offſpring, inſtead of being barren, were found to be equally prolific as their parents. The goldfinch and Canary bird, the red-breaſted

Anſwered: Neither the ſkin, nor any part of the ſkeleton was preſerved, nor can now be had; though the declarant has often regretted the not preſerving the foal, as its mother always performed any work that a horſe of fifteen pounds value could do.

5to, Is the mother ſtill alive? What is her age?

Anſwer: The mother died, about eight years ago, of an epidemic cold that was raging among the horſes in this country: The mule had little or no milk after foaling, and the foal got ſome cow's milk: And this is all he remembers of the matter.

DAVID TULLO.

Auchtertyre, 4th February 1780

We James Small tenant in Burnmouth, and Robert Ramſay tenant in Newtyle, hereby certify, That we have often ſeen the mule above deſcribed, and we know that ſhe had a foal, as is narrated by David Tullo.

JAMES SMALL.
ROB. RAMSAY.

Ballintyne-houſe, 4th February 1780.

The within interrogatories were put to David Tullo, tenant in Auchtertyre, anent the mule he had, and the foal ſhe produced, to which he gave the anſwers ſubjoined to each query, and ſigned them, as did James Small and Robert Ramſay, atteſting the truth thereof, in preſence of

GEORGE WATSON, J. P.

The original atteſtation is in my poſſeſſion; and I lately tranſmitted notorial or authenticated copies of it to the COUNT DE BUFFON, and to THOMAS PENNANT, Eſq; of Downing in Flintſhire

breaſted and common linnet, have been ſubjected to theſe trials, and the hybrids or mules produced by them uniformly retained their prolific powers *.

I cloſe this ſection with remarking, that Nature ſeems to indulge more frolics in the myſteries of Venus than philoſophers are apt to imagine; and that ſome animals whom we are taught to regard as diſtinct and original ſpecies, may only be mules endowed with the faculty of tranſmiſſion.

* See Buffon des Oiſeaux, Tom. I. p. 22. and Tom. IV. Art. du Serin des Canaries.

SECT. II.

Of a Plan for raiſing the raw material of Silk *in Britain—The texture of Inſects is extremely ductile—From many circumſtances in their hiſtory, it ſhould appear that different kinds intermix, and produce new and fertile ſpecies—Upon this view of Nature, a probable plan for producing the raw material of a Silk Manufacture in Britain is ſubmitted to the conſideration of the Public—The experiment is eaſy, attended with no expence, and highly worthy of a trial.*

INVENTION is often the offſpring of accident: But prejudice, or fixed opinion, is an inſurmountable barrier to every invention that depends upon a proceſs of reaſoning. A mind, fettered by a ſtrong predilection for particular notions, can never move with freedom, or view objects in different aſpects; and, of courſe, has not even the chance of ſtumbling on novelty. Unfortunately for ſcience, this is a very general characteriſtic of the human ſpecies. We are gregarious animals, not in the phyſical ſenſe alone: With regard to opinion and belief, this herding quality is a more ſtriking feature in the complexion of humanity. Strongly impreſſed with the force of this truth, ſome philoſophers run into the oppoſite extreme. Becauſe moſt men believe without reaſon, there are others whom no reaſoning can convince. Between the two ingenuous minds

minds are confounded, ſubjects of moment are conſidered either as inſcrutable or as perfectly known, and the ſpirit of reſearch receives a mortal wound.

To give general currency to a hypothetical notion, requires only the adventitious aid of a few great names. If, upon this ſlight baſis, the fabric reſts for a few years, ingenuity, argument, and even experiment, may open their ineffectual batteries. Such is the incorrigible attachment to what men call *authorities*, that nothing but *greater authorities* can eradicate an eſtabliſhed prejudice. This temper, which originates from weakneſs, credulity, and indolence, is perhaps the greateſt obſtruction that ſcience has to encounter in its progreſs toward perfection. Hence the man who refutes a received theory does more ſervice to ſcience than its inventor; becauſe he unſhackles the mind, and freſh inquiries proceed without embarraſſment. New views, for the ſame reaſon, which require the illuſtration of experiment, are of the greateſt utility; for, though the notions ſhould turn out to be falſe, unlooked for truths riſe up in the courſe of the reſearch. Notwithſtanding HARVEY's ſyſtem of *eggs*, LEUWENHOEK's *homunculi*, BUFFON's *living organic particles*, and BONNET's *infinite ſeries of germs*, the theory of generation is ſtill involved in the deepeſt obſcurity; yet the inquiry has enriched anatomy and ſcience with many new and valuable facts.

Becauſe mules from the aſs and mare were ſuppoſed to be barren, it has been concluded, and even recognized as a law of Nature, that every anomalous production muſt likewiſe be denied the faculty of procreating. The wiſdom of the Creator has been celebrated in the eſtabliſhment of this law. It has been regarded as a barrier againſt the mixture and confuſion of ſpecies; and the ſacredneſs of the imaginary

ginary inſtitution has almoſt totally precluded all inquiry into the ſubject.

The ingenious M. DE BUFFON, however, ventured to inveſtigate the truth. He brought direct evidence, that the common mule, a production from two of the moſt unprolific quadrupeds, is not deprived of the power of multiplying. Even in our own climate, we had lately an inſtance of a prolific ſhe-mule *.

By revolving theſe and ſimilar ideas, I was led to the following views, which, with much deference, I ſubmit to the attention of the public. For the ſake of brevity, I ſhall deliver moſt of them in the form of queries.

I. As we are ignorant of many circumſtances in the œconomy of animals, and, as it is certain, that mongrels from the commixture of different ſpecies of ſmall birds have the power of tranſmitting the kind, may we not conclude, that the ſuppoſed law of ſterility in mules is at leaſt not ſo general as we have been taught to believe?

II. As the experiments have hitherto been confined to the moſt ſterile quadrupeds, may we not reaſonably expect, that trials made upon the more prolific animals, as the ſow, the rabbit, &c. would afford ſtill farther proofs of the fœcundity of anomalous beings?

III. Deſcending lower in the ſcale of animation, till we come to frogs, lizards, and the reptile race, whoſe prolific powers are amazing, and in whom Nature aſſumes a more ſoft and ductile texture,

may

* See p. 145.

may we not hope to procure multitudes of mules endowed with the faculty of tranſmiſſion?

IV. Proceeding ſtill lower, till we arrive at the inſect tribes, do not ſimilarity of texture, aſtoniſhing fertility, the ſame mode of generating, a great coincidence in the ſtructure of parts, both external and internal, the living on the ſame or ſimilar nouriſhment, and many other circumſtances, concur in marking them out as the fitteſt objects for trials of this kind, and from which the greateſt ſucceſs is to be expected?

The chief obſtruction to the execution of trials of this nature ariſes from the difficulty of alluring different ſpecies into mutual and ardent embraces. In one tribe of inſects, however, I imagine, that this difficulty will be completely removed. The numerous tribe of butter-flies, after eſcaping from the chryſalis ſtate, ſeem to have no other deſtination but that of propagating and continuing the kind. They no ſooner burſt through the fetters of the chryſalis, than they roam about in queſt of a mate with all the fervours of deſire. When they meet their object, they obey with alacrity the commands of Nature. After the operation is finiſhed, the female lays her eggs, and the male acquires a torpid aſpect. The intention of Nature being thus compleated, both male and female fall victims at the altar of Venus.

As butterflies die very ſoon after procreating, and, as they have few other deſires while in that ſtate, is it not probable, that, when excluded from their particular kinds, males and females of different ſpecies will ſpontaneouſly unite? From this union, is it not likewiſe probable, that the eggs of the females will be impregnated?

From

From the accurate diſſections of the celebrated REAUMUR it appears, that the parts of generation in the various kinds of butterflies are extremely ſimilar. From the ſeveral metamorphoſes to which they are ſubjected, the ductility of their texture is alſo apparent. When, to theſe facts, we add their great prolific powers, is it not reaſonable to ſuppoſe, that anomalous productions from different ſpecies will continue to be fertile?

This reaſoning may eaſily be ſubjected to the teſt of experiment. Let any perſon feed a variety of caterpillars in ſeparate boxes. When transformed into moths or butterflies, let the males and females of different ſpecies be admitted to each other. The effects of theſe trials time alone can determine. If it happens, as there is great reaſon to expect, that theſe inſects freely unite; that the eggs of the females are impregnated by this union; and that the ſpurious offspring are endowed with prolific powers, and perpetuate the kind, then will philoſophers have the ſatisfaction of ſeeing an univerſal prejudice, concerning the oeconomy of animals, completely removed.

The mere gratification of curioſity would juſtify a ſet of experiments that require ſo little time, trouble, or expence *. But the idea of utility gives alacrity to inveſtigation. Conſidering whether ſome uſe might not be derived from theſe projected trials upon butterflies, the following notion, which, perhaps, may be regarded as fanciful, occurred.

The ſilk worm is a native of warm climates. Its conſtitution is too

* About fourteen years ago, I attempted to make theſe experiments. But, from my ſituation in a large city, and the want of proper food, I found that my ſilk worms died before they arrived at maturity.

too delicate to bear the cold and the viciſſitudes of our weather. Neither is the mulberry, the proper food of the animal, raiſed here in ſufficient quantities. Theſe are the chief obſtructions to the culture of ſilk in this country. But large ſums of money are annually ſent out of Britain for purchaſing raw ſilk. Hence any rational ſcheme for preventing this expenditure merits the attention both of philoſophers and of the public. I deſpair not of ſeeing this deſirable end accompliſhed. I even look forward with joy to a period, which I hope is not diſtant, when the production of good ſilk will be as common in Scotland as in any other nation in Europe, or Aſia.

The mode I propoſe is ſimple; and therefore its ſucceſs is the more probable. In this country, we have many caterpillars which ſpin pods of no inconſiderable ſize and goodneſs. A caterpillar that feeds upon the pear-tree, and is produced from the fly called *Phalaena pavonia*, or *peacock-moth*, ſpins a large pod, the ſilk of which is coarſer and ſtronger than common ſilk. Another ſpecies, called by the French *la livrée*, feeds on the leaves of moſt fruit trees, and ſpins a pod extremely ſimilar to that of the ſilk worm. Other caterpillars, poſſeſſing the ſame qualities, live upon the oak, the elm, the plane, &c. But it is needleſs to give a more enlarged enumeration. Now, commixtures with the butterflies of theſe caterpillars and the ſilk-fly will, I imagine, produce worms attempered in conſtitution to the climate of Britain, capable of being nouriſhed by ſome of our indigenous plants, endowed, at the ſame time, with the faculty of perpetuating the kind, and of ſpinning a ſilk equal, if not ſuperior, to that imported from warmer regions.

To this ſcheme it may be objected, that, on the ſuppoſition of its practicability, the ſpecies of butterflies ſhould be perpetually augmenting,

menting, and that to their variety there ſhould be no end. I anſwer, that this objection ſtrengthens the probability of the plan; For the varieties of the butterfly and moth, already known and deſcribed, amount nearly to 1000. Many of theſe, I doubt not, have been produced by accidental commixtures. Two cauſes concur in preventing ſuch a frequency of commixtures of this kind as might be imagined. Many ſpecies of caterpillars aſſociate, and fix their chryſales upon particular plants or places, and, immediately after their metamorphoſis, the males attach themſelves to the females. Other ſpecies not only aſſociate, but eſcape from the chryſalis in particular months of the year, as if Nature meant to prevent their uniting. Some kinds come out only in April, others in May, June, July, Auguſt, and September. Theſe and other circumſtances render the accidental concourſe of males and females of different ſpecies much leſs frequent than if all the kinds lived at the ſame time, and fed upon the ſame plants.

It may likewiſe be objected, that, as different ſpecies are transformed in different months, and as the flies die ſoon after their change, it will be impoſſible to try theſe projected experiments with kinds which come out of the chryſalis ſtate at the diſtance of one or two months from each other. This objection is removed by two ſingular facts. It is true, that coition debilitates and quickly kills butterflies. But, when confined, and prevented from mutual embraces, they preſerve both their exiſtence and vigour for five or ſix months *. Beſides, from the accurate experiments of REAUMUR, we learn, that the duration of the chryſalis ſtate may be prolonged

* Wahlbom in Amoen. Acad. Vol. I. p. 105.

or ſhortened at pleaſure, by the application of different degrees of heat and cold

Upon the whole, I moſt ſeriouſly recommend this idea to the attention of men who have leiſure, and who are properly ſituated, to give the project a fair trial. If my ideas be right, the perſon who realiſes them will not only make a fortune, but immortaliſe his name.

CHAP.

* Reaumur, Tom. III. 12mo. edit. p. 11.

CHAPTER IV.

Of the Varieties of Man which have hitherto been diſcovered in every region of the Globe—Varieties in Colour—in Stature—in Figure and Features—in Manners and Cuſtoms—in Religion, and Religious Opinions and Ceremonies—Of Cannibals both ancient and modern—Of Human Sacrifices in the Old and New Worlds—Of War and Warlike Inſtruments—Of Agriculture, and the Spontaneous Productions of the Earth—Of Marriages, Burials, Civil Government, Arts and Manufactures, &c. &c.

WITH regard to colour, in the human ſpecies, from black it runs through almoſt every poſſible ſhade till it arrives at what we denominate *white*. Many circumſtances give riſe to differences in the colour of the ſkin. Even in the ſame climate, in the ſame town or village, marked ſhades of colour are to be obſerved not only in individuals, but in whole families, and theſe ſhades are generally tranſmitted to poſterity, except when the breed happens to be croſſed by races of individuals of a different complexion, which produces an intermediate ſhade. In a large city, independent of foreign commixtures, what a variety of colours are to be perceived?

Notwithſtanding theſe local, and often hereditary ſhades, which take place in the ſame climate, and even in a ſmall diſtrict of the ſame

ſame country, Nature, from particular ſituations as to heat and cold, produces diſtinctions of the moſt marked kinds.

In the Old Continent, however, the deepeſt ſhade of black is to be found in the Torrid Zone. From this region of the earth, as we approach either to the ſouth or north, the colour of the human kind gradually becomes more and more white, till we arrive at the temperate climates, where the complexion, to our eyes, at leaſt, is moſt beautiful. But our ideas of beauty are entirely relative. To a negroe, the deepeſt black is the moſt admired colour in a female; and the ſame ſentiment i[illegible]d muſt be entertained by people of all intermediate colours.

In proportion as we recede from the equator, either to the ſouth or the north, the ſhades of colour become always whiter and whiter. But here Nature, correſpondent to her uniform procedure, reverſes, or rather confirms, her original plan. From the negroes under or near the line, to the termination of the temperate zone, the gradations of colour are to be aſcertained. But, what is ſingular and curious, after paſſing north of the temperate zone, the colour of the natives is not only more ſwarthy, but again approaches to blackneſs. From this fact, which is perfectly known, it ſhould ſeem, that extreme heat and extreme cold produce nearly the ſame appearances on the human ſkin.

The inhabitants of Lapland and of Nova Zembla, the Borandians, the Samoiedes, the northern Tartars, the Oſtiacks, the Greenlanders, and the ſavages to the north of the Eſquimaux Indians, ſeem to be the ſame race of people. All of them have broad large faces, and flat

flat noſes *. Their eyes are of a yellowiſh brown colour, inclining to black †. Their eye-lids extend towards the temples; their cheek-bones are remarkably prominent; their mouths are large, and their lips thick and reflected; their voice is ſqueaking; their head is large; their hair black and ſmooth; and their ſkin is of a tawny or ſwarthy hue. Their ſize is diminutive, moſt of them not exceeding four feet high; and their talleſt men are not above four feet and a half. This numerous race of people differ ſo much from all others, that they appear to conſtitute a diſtinct ſpecies. The Borandians are ſtill ſmaller than the Laplanders. The iris of their eyes is of the ſame colour; but the white is of a reddiſh yello[illegible]. Their ſkin is more tawny; and their legs are very thick and ill-ſhaped.

The Samoiedes are more ſquat than the Laplanders; their heads are larger, their noſes broader, their complexion darker, their legs ſhorter, and their beards more ſcanty of hair. The ſkin of the Greenlander is more tawny than that of the other nations, being of a deep olive colour. It is even ſaid, that ſome of them are as black as the African negroes. The women, among all theſe nations, are as ugly as the men, and reſemble them ſo much, that the diſtinction is not eaſily to be perceived. In Greenland, the women are very ſhort; but their bodies are well proportioned. Their hair is blacker, and their ſkin ſofter than thoſe of the Samoiedes. Their breaſts are ſo long and flexible, that they can ſuckle their children over their ſhoulders. Their nipples are as black as jet, and their ſkin is of a deep olive colour. Their viſage is large, their eyes ſmall, but black and vivacious, and their feet and hands are ſhort. In all other reſpects,

* Le Voyage de Regnard, tom. I. p. 169. et Les Voyages du Nord faits par les Hollandois.

† Linnæ Fauna Suecica, 1746, p. 1.

reſpects, they reſemble the Samoiede females. The ſavages north of the Eſquimaux, and even in the northern parts of Newfoundland, have a great reſemblance to the Greenlanders. Like them alſo, their ſtature is ſmall, their faces broad, and their noſes flat. Their eyes, however, are larger than thoſe of the Laplanders.

All thoſe races reſemble each other not only in deformity, in lowneſs of ſtature, and in the colour of their hair and eyes, but likewiſe in their diſpoſitions and manners. All of them are equally groſs, ſtupid, and ſuperſtitious. The Daniſh Laplanders keep large black cats, to whom they communicate their ſecrets, and conſult in all their important affairs. In every family, among the Swediſh Laplanders, a drum is kept for the purpoſe of conſulting the devil; and, though they are robuſt and nimble, ſuch is their puſillanimity, that they never could be perſuaded to face a field of battle. Guſtavus Adolphus attempted to embody a regiment of Laplanders; but he was obliged to relinquiſh the project. They cannot, it would appear, exiſt any where but in their own country, and in their own manner. They travel on the ſnow with ſkates made of wood, about two yards long, and half a foot in breadth. With theſe they run on the ſnow ſo rapidly, that they overtake eaſily the ſwifteſt animals. They uſe a long pole, pointed with iron at one end, and rounded at the other. By means of this pole, they puſh themſelves forward, direct their courſe, prevent their falling, ſtop their impetuoſity, and kill the animals they purſue *. The ſkates employed by the Samoiedes are ſhorter, ſeldom exceeding two feet in length. They likewiſe uſe the bow and the croſs-bow; and the Muſcovite Laplanders are ſaid to dart a javelin with ſuch force and dexterity, that, at

* A ſpecimen of theſe ſkates may be ſeen in the Muſæum of the Antiquaries of Scotland.

at the diſtance of thirty paces, they often hit a mark not larger than a crown piece. They hunt the lynx, the fox, the martin, and the ermine, and barter their ſkins for brandy and tobacco. Their principal food is dried fiſh, and the fleſh of the bear and rein-deer. Their bread conſiſts of the pounded bones of fiſhes, mixed with the tender bark of the birch or the pine tree. Their common drink is whale-oil, or water in which the berries of the juniper have been infuſed. They are, in general, idolaters and extremely ſuperſtitious. More groſs than ſavages, they have neither courage nor a ſenſe of ſhame. They bathe promiſcuouſly naked, boys and girls, mothers and ſons, brothers and ſiſters, without feeling the ſmalleſt ſenſe of impropriety. They offer their wives and daughters to ſtrangers, and think it the higheſt affront if the offer be rejected. This cuſtom is univerſal among the Samoiedes, the Borandians, the Laplanders, and the inhabitants of Greenland. The Laplanders, in winter, clothe themſelves with the ſkin of the rein-deer, and, in ſummer, with the ſkins of birds.

In Nova Zembla, the women pierce their noſes and ears, and ornament them with pendants of blue ſtones; and, to augment their charms, they draw blue lines acroſs their forehead and chin. In Greenland, the women clothe themſelves with the ſkin of the dog-fiſh. They likewiſe paint their faces blue and yellow, and wear pendants in their ears. All of them live under ground, or in huts ſunk almoſt below the ſurface, which they cover with the bark of trees, or with the bones of fiſhes. During winter, it is a common practice with them to make ſubterraneous communications from one habitation to another, by which they are enabled to viſit their neighbours without going abroad. Darkneſs, continued for ſeveral months, obliges them to illuminate their dreary abodes with lamps,